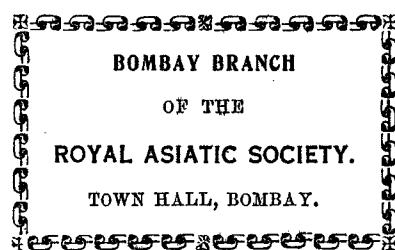


*Progress of
Sanitary Measures in India*



00134532



EAST INDIA (SANITARY).

PROGRESS

OF

SANITARY MEASURES IN INDIA.

Presented to both Houses of Parliament by Command of His Majesty.



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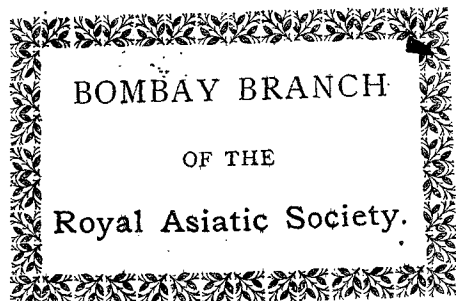
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No. 1.

IMPERIAL MALARIA CONFERENCE, OCTOBER, 1909.

(For Agenda Paper, see p. 2.)

FIRST DAY.

Tuesday, October 12, 1909.

PRESENT :

His Excellency the Viceroy and Governor-General of India.

His Honour the Lieutenant-Governor of the Punjab.

The Honourable Sir Herbert Risley, K.C.I.E., C.S.I., I.C.S., Member of Council in Charge of the Home Department.

Sir Harold Stuart, K.C.V.O., C.S.I., I.C.S., Secretary to the Government of India, Home Department.

The Delegates to the Conference.

His Excellency the Viceroy opened the Conference with the following address :—

GENTLEMEN,

I MUST in the first place welcome you heartily to Simla. I assure you I fully appreciate the strain that a break in the everyday work of busy men must always cause—to say nothing of the personal inconvenience of the long journeys many of you have had to undertake. And I recognise too the public spirit of the local Governments who have deputed officers to represent them in your coming deliberations, who could not be easily spared from the important posts they fill.

But, gentlemen, the subject which I have invited you to Simla to discuss has seemed to me of such vital importance as affecting the health and therefore the welfare of the vast populations of this country, that it could not adequately be dealt with by local effort—or rather that local effort would be far more likely to succeed if the general principles upon which the ravages of malaria are to be combated were discussed by a central assemblage in possession of a full knowledge of all local characteristics and possibilities. There are many conditions which may influence local Governments in the line of action they may think it best to adopt. But, on the other hand, we appear to me to be confronted with certain facts not only as to the deplorable results of a terrible sickness, but as to well-ascertained means of counteracting them,—facts which demand the joint consideration of all local authorities and the joint acceptance of the plan of campaign it may be advisable to adopt.

It is with this view that I have convened an Imperial Conference on Malaria. It rests with the Conference to discuss a great hygienic problem, and I have been anxious that in the composition of the Conference the Government of India should have the benefit not only of expert but of administrative and lay opinion. I need hardly tell you that on hygienic matters I am myself a layman, and it is with the utmost humility that I venture to address the galaxy of expert talent I see before me. But still the people of India are laymen like myself—we know of a dread disease and of a dismal death-roll; we read of the weapons with which we are told it can be effectually fought, and we look to you as experts to help us.

I am afraid that very often in this world of ours it requires some sudden crisis to bring home to us the existence of an evil which has long been in our midst. Malaria is no new ailment. The cruel epidemic which raged last autumn in the United Provinces and in the Punjab exceptionally emphasised its dire consequences and has impressed upon public opinion the magnitude of the question with which the Government of India is called upon to deal, yet we must remember that much as the Punjab and the United Provinces have suffered, there are many districts in Bengal where the people have died in thousands during past years and where the strength of the population has been undermined. Malaria has been a terrible scourge in many parts of India. I have no wish to weary you with a repetition of statistics which are no doubt well known to all of you, but speaking generally, the number of deaths ascribed to fever in the whole of India has varied during the last 10 years from about 4 millions to 4½ millions per annum; and though it is admitted that only a portion of these are due to malaria, and though we cannot say with precision what that proportion is, it has been estimated to be from one-fourth to one-fifth of the total number of deaths entered in our returns as due to fever. We may therefore take it that malaria is answerable in an ordinary season for about a million deaths in the year. But last year the number of deaths ascribed to fever was one million more than the normal, and there are grounds for belief that this additional million was due to malaria and not to the other diseases which

go to swell the total returns under the heading of fever. We may therefore assume that the number of deaths from malaria in India are ordinarily one million, but that in an exceptional season they have risen to two millions. If we admit such a conclusion, as I am afraid we must, we cannot disguise from ourselves the magnitude of the evil with which we have to deal. And the loss by death is by no means the whole of that evil. There are the cases of those who contract the disease, but do not die, and the ratio of the number of such cases to the number of deaths is very high. I believe one estimate has placed it as high as 133 cases of sickness to one death. If therefore we take it only in the proportion of 50 to 1, we have to admit 100 million cases of fever for last year which were not fatal. It is appalling to think of the suffering and economic loss that such conditions imply—not only direct and immediate loss by the death and sickness of adults, but potential loss in the case of the children. And yet much of this widespread suffering scientists assure us is preventible. The chief problem before the Conference will be to discover by what means that assurance can best be confirmed.

I have already told you, gentlemen, that I am addressing you entirely as a layman. I am in no way entitled to enter the arena of scientific hygienic discussion, but I gratefully acknowledge the debt of gratitude we owe to the comparatively recent discoveries of the secret history of the world-wide disease this Conference has assembled to consider. We all know the old theories about malaria,—the Italian derivation of the word illustrates them: *mala aria*, bad air; air tainted by injurious emanations from animal or vegetable matter; noxious exhalations of marshy districts; in other words miasma. It has, too, been ascribed to the “Sirocco,” that disagreeable wind, the relaxing effects of which are, I am sure, known to any of you who have frequented the shores of the Mediterranean. Those were the beliefs of old days, and it was not till 1880 that Laveran, a French Army Surgeon, discovered the malarial parasite and his views were not accepted until they were confirmed some years later, by Italian scientists. In 1894, Sir Patrick Manson suggested that the malaria parasite probably had some kind of mosquito as an intermediate host which was necessary for its development, and it was only in 1897 that, acting on that suggestion, Major Ross made the brilliant discovery which I may perhaps venture to say solved the problem of the etiology of malaria and earned for him not only the admiration of scientists, but the thanks of the world at large. Major Ross’s discovery has been put to practical test in Italy, Panama, Ismailia, and at other places, and there would seem to be no reason to doubt that if man can be protected from the bites of infected mosquitoes, he will not contract malaria. This however confronts us with another problem—is it always possible to exterminate a particular kind of mosquito from malarious localities. The answer I venture to think rests rather with the administrator than with the doctor and man of science. I am afraid, gentlemen, I have not the hardihood to enter into the controversial atmosphere which surrounds the question—I must leave it to you to decide to what extent the malaria mosquito has been personally vanquished in the past or can be utterly defeated in the future. Much must depend upon the development of sanitation, upon carefully considered organisation, and last but not least, upon financial possibilities. But, however, that may be, whilst readily admitting the value of the great discoveries to which I have referred, we are mercifully, in our struggle with malaria, not merely confined to the direction of an anti-mosquito campaign. We have other means of attack at our disposal. For there is ample evidence of the marvellous results due to the administration of quinine as a prophylactic—I, of course, mean as a prophylactic administered upon systematic and well-thought-out lines. Dr. Osler—Regius Professor of Medicine at Oxford—in a letter to the *Times* in the spring of this year told us his experiences of preventive treatment of malaria in Canada. The same treatment has also met with marked success on the Panama Canal, whilst in Italy in malarial districts quinine is distributed in the shape of comfits and chocolates. Dr. Bentley has written in the same sense of his experiences in India, and Lieutenant-Colonel Braide has told us of the very satisfactory results due to prophylactic treatment in the prisons of the Punjab under his charge. So that the Conference will have before it two important facts, Major Ross’s discovery of the actual cause of malaria, and the evidence, which I think we may assume to be incontrovertible, that where quinine can be systematically administered as a prophylactic, a very general immunity from malaria will be the result. It will rest with the Conference to decide by what means the knowledge of these two great facts may best be utilised. The practical application of that knowledge must involve the consideration of many points of detail upon which it would be

useless for me to enter to-day, but which will require much careful and searching enquiry—as a basis for which the Conference will, I am glad to say, have before it an able paper by Colonel Leslie embodying his proposals for the systematic investigation into the possible prevention and treatment of fevers.

Gentlemen, I have only attempted to outline the general conditions, as they appear to me, surrounding the consideration of the problem with which you will have to deal—a problem of Imperial magnitude—inasmuch as it affects the health and happiness of this great country—the successful solution of which must depend upon the united efforts of the administrations and varied interests which you have assembled here to represent. It is my earnest hope that the results of your deliberations may—by the inauguration of a campaign against what we now know to be a preventible disease—confer a great boon upon the people of India, and though the campaign must of necessity be long and hard fought, I open this Conference in the firm belief that it will eventually be crowned with success.

The following paper was then read:—

Malaria in India by Lieutenant-Colonel J. T. W. Leslie, M.B., C.I.E., I.M.S.

Before beginning the regular business of this Conference it seems to be desirable that you should have before you a rough sketch of the position of the problems of which we are to endeavour to find some solution, namely, the reduction of the amount of malaria infection in India and the mitigation of the results of infection.

A reference to any recent Report of the Sanitary Commissioner with the Government of India will show that out of a total number of about eight million deaths recorded during the year, $4\frac{1}{2}$ millions were registered under the heading “fever.” Many people assume that all these fever deaths are due to malaria, but a very cursory examination of the details of the statistics will show that this assumption is erroneous. If, for instance, we turn to the statistics recorded in Sind in 1907, we find that the total death-rate was 22·4 per 1,000, including a death-rate from fever of 19·2. If all the deaths which appear under the heading “fever” had been due to malaria, all the other diseases to which flesh is heir caused only 3·2 deaths in every thousand of the population. This is obviously absurd. If we now look at the statistics of Karachi for the same year, we find that the total death-rate—unhappily very high owing to the prevalence of plague—was 49 per thousand, including a death-rate from fevers of 7 per thousand. As a matter of fact, the registration of vital statistics in India, except in a few of the towns, is carried out by means of an illiterate agency, and although in many provinces the total figures are surprisingly correct, the registered causes of death are always very misleading. The heading “fever” represents pneumonia, tubercle of the lungs, diseases of the kidneys, and indeed, all the so-called medical diseases, except diseases like cholera and small-pox of which the distinctive signs are unmistakable by the people themselves.

The total number of deaths registered under the heading “fever” is remarkably constant from year to year, the figure being a little short of $4\frac{1}{2}$ millions, and the mean death-rate rather less than 19·5 per thousand. During the last ten years death-rates have been raised owing to plague, but we may say that if, in a given year, the total Indian death-rate was 35 per thousand, four-sevenths of it, or 20 per thousand, would be ascribed to fever.

The question that at once occurs is, “what proportion of this death-rate of 20 per 1,000 is due to malaria?” and obviously, in the circumstances in which deaths are registered, this is an exceedingly difficult question to answer with any degree of accuracy, but from the indications afforded by certain special enquiries, from the dispensary reports, and other sources, it has been estimated for the whole country at about one-fourth, that is to say, the mean death-rate from malarial fevers, in an ordinary year, and taking the country as a whole, is about 5 per thousand. This means that in an ordinary year malaria causes about 1,130,000 deaths, and as in such a year it is not a very fatal disease, this number of deaths represents an enormous amount of suffering and loss of labour, often at the time when labour is of most value. It is impossible to judge of the amount of suffering or to frame an estimate of the economic loss, because we have no trustworthy data regarding the degree of fatality of the disease among the people.

A rough idea of the extent to which death from malaria is preventible in India may be formed from a study of the effects of the disease in the Native Army

and in jails, but, of course, in any comparison of the statistics referring to soldiers and prisoners with those of the general population, we must not omit to make allowance for the age and sex constitution of the populations compared, and for the peculiarly favourable conditions in which preventive measures act among bodies of men under skilled control.

The Native Army consists of picked men who, when they are with their regiments, are looked after carefully in health and skilfully tended when sick. The admission and death-rates ascribed to malaria have declined in recent years, but during each of the ten years ending with 1907 it may be said that three men in every 2,000 died from its effects.

Prisoners are greatly inferior to soldiers in physique and they are subject to the depressing effects and monotonous routine of jail life. Moreover, there is a continuous flow into and through the prisons of individuals, many of them infected with malaria, taken from the lowest and poorest ranks of society. Still, far more stringent measures of prevention are possible in jails than in regimental lines, and the results are consequently better, so far as malaria is concerned. In each year of the decennium, on an average, four prisoners in each 3,000 died from malarial fever.

When the deaths ascribed to malaria in the jails are closely investigated, it is found that in a considerable proportion of the cases death was due to a cause other than malaria, so that the mean death-rate of the ten years, which on paper is 1·30 per thousand, is in fact only about 1 per thousand. That is to say, the death-rate among prisoners from malarial fevers is about one-fifth of what it is among the general population. A comparison of a death-rate among prisoners with that among the general population is misleading owing to the numbers of children and old people among the latter, but preventive measures are by no means perfect in the prisons, and perhaps we may say that if we could place all the people in fairly good hygienic conditions, give them prophylactic doses of quinine during the fever season and provide them with suitable food and skilled attendance when they are attacked, we should prevent three-fourths of the deaths from fever that now occur. This is perhaps rather speculative—certainly there are a good many “ifs” about it. Our experience in prisons does show this, malarial fever properly treated is by no means a fatal disease among adults. Last year (1908) malarial fevers were extraordinarily prevalent and fatal in north-western India. During the year there were 20,039 cases of fever admitted into the jail hospitals throughout the country, and only 105 of those cases terminated fatally. Assuming that all the 105 died from malaria, which the *post mortem* records show was by no means the case, this means that only one in 191 cases of fever ended in death, and this in a year when the fever was peculiarly deadly. Contrast this with the state of affairs among the general population in the United Provinces in 1908, when one person in every 24 died of fever—in that year mostly malarial. Why is it that a disease which is so rarely fatal to a prisoner should be so often fatal to a free man?

A very large fraction of the total mortality from fever among the general population occurs among children and the aged, and in epidemic years they suffer disproportionately, because in such years, for reasons which we shall presently mention, they have to suffer from privations which loosen their feeble hold on life. In the Punjab in 1908 the infantile death rate from fever was doubled and the fever death rates among children between the ages of 1 year and 10 years of age were more than doubled. While due allowance must always be made for the share of the total mortality occasioned by malaria among the very young, it seems to me that, in normal years at any rate, there is sometimes a danger of exaggerating it, for it is not uncommon to find practically all the deaths occurring in infancy attributed to malarial fevers. Now we know that, in temperate climates, where there is no malaria, the mortality in infancy even in favourable circumstances is high; and in a tropical or sub-tropical country with a very high birth rate, we cannot expect children to escape the effects of mal-nutrition, bowel complaints, parental ignorance, and other special dangers of childhood.

In normal years I believe many of the deaths which result from malarial fevers are directly due to the treatment, or rather want of treatment of the cases. I do not refer to the neglect of medicinal remedies, but to the withholding of food. In this country and in some others it is an article of popular superstition that a fever should be starved, and the sufferer and his friends believe that the taking of food

brings on the attack of fever. Too often it is the sufferer that is starved and not the fever.

In any place in which malaria exists meteorological conditions may determine a severe epidemic of fever, when the disease becomes not only much more common, but enormously more fatal than in ordinary years.

When heavy rains precede a severe outbreak of fever, they cause floods, when large tracts of country are submerged, houses collapse, harvests are destroyed and the poorer classes of the peasantry are not only thrown out of employment, but are exposed to great privation and hardship. It is then that the mortality among children and the aged is so high—malaria, owing to the simultaneous occurrence of exposure and privation, has become a very fatal disease. These are obvious considerations, but there are others which have not yet been fully elucidated. The floods, of course, produce lasting pools of water in which mosquitoes breed, but a feature of these autumn epidemics is the suddenness of their onset, which it seems can be accounted for only by large numbers of mosquitoes being very rapidly infected.

In the towns, in India as in other countries, there are numbers of people who lead a hand to mouth existence; ill-housed, ill-clad and ill-fed, they pick up a precarious livelihood in the unskilled labour market. Such people have unsuitable food at the best of times, and they have no savings, so that when anything occurs to check the demand for such work as they can do, the scanty coarse food becomes scantier and coarser, and they and those dependent on them offer little resistance to malarial infection and readily succumb to its effects.

Analogous conditions, as pointed out, by Christophers and Bentley, may be artificially produced in any area in which anopheles mosquitoes can breed, when large numbers of labourers are collected in it under bad hygienic conditions. The majority of such labourers are free from infection, but are highly susceptible to it, a few are infected, and all are dependent on their daily labour for their daily bread. Infection spreads and with it the inability to earn money to pay for sufficient food, privation added to malaria determines a severe attack, attacks are repeated and here again the disease is a very fatal one.

The cause of malaria is a sporozoan parasite of which there are three species generally recognized. These parasites pass the sexual phase of their lives in certain mosquitoes and the asexual phase in the blood of man. The important fact in respect of the prevention of malaria is that in nature the parasites occur in both hosts and, so far as is known, nowhere else.

Preventive measures are founded on this fact and have for their object the destruction of the insect host, the prevention of the transference of the parasites from one host to the other, or the destruction of the parasites in the blood of man.

It is unnecessary to enumerate in detail the devices which have been used to effect these objects, they may all, I think, be classified under three heads:

- (1) The extermination of mosquitoes.
- (2) The prevention of bites.
- (3) The administration of quinine.

The prevention of bites is useful as a supplement to more radical measures but, so far as this is effected by wire gauze screens and mosquito curtains, which are expensive and require careful handling, the use of the measure must be limited to the wealthier classes.

Much I believe could be effected by improving the design of living rooms and dormitories. It seems obvious that a well-ventilated white-washed room will afford less shelter during the day to mosquitoes than a dark dingy room. Anointing the body with substances offensive to mosquitoes is useful on occasion.

Of the two radical measures, one aims at the extirpation of mosquitoes by abolishing their breeding places or destroying the eggs, larvæ or mature insects, the other aims at destroying the sporozon by the administration of quinine and there has been much controversy regarding the merits of the two measures. It has always seemed to me to be unfortunate that so many of the writers who contribute their views on this controversy to the public press have not been at the pains to study the original accounts of the experiments on which any opinion of value must be based. The consequence of so much wild writing has been to confuse the issue, and not only the intelligent layman, but even medical men have been led astray.

It is obvious, if malaria is due solely to the bites of anopheles mosquitoes,

that the extirpation of these mosquitoes will abolish malaria. It will be admitted by everybody that the continuous use of quinine, even for a short time during the year, is inconvenient and unpleasant to the individual and difficult to carry out among a community. It is therefore evident that the best way to get rid of malaria is to destroy the mosquitoes. The only questions are, can it be done? and, if it can, at what cost? It has been successfully done at Ismailia, but in conditions which were extraordinarily favourable, such, as I fear, occur very rarely, if they ever occur, in India.

Ismailia was built about 35 years ago by the Suez Canal Company as a model town. It is situated on the shore of the bitter lake Timsah, with the desert behind it. The water supply is derived from the fresh-water canal.

In his report to the Liverpool School of Tropical Medicine, published in January, 1903, Major Ross pointed out that "almost the whole of the irrigation system of Ismailia is free from larvæ and is unfavourable to their propagation," and that "the waters which really occasion malaria are the most shallow and insignificant surface pools, which could be filled up and drained away without difficulty and without detriment to cultivation or irrigation," indeed, he remarked, "mosquitoes can be extirpated with great facility at Ismailia, in fact with much greater facility than in any other town I have seen." Fever is said to have appeared in Ismailia in 1877, but it was never severe, and only three or four pernicious attacks had occurred from the commencement of the epidemic until 1902. Major Ross says "The illness does not appear to be of such a severe type as I have met with in parts of India and Africa; and no deaths have been reported."

The population of the town is 7,000 or 8,000; the Canal Company is the controlling force everywhere; there are no prejudices to overcome; there is no lack of money; the soil is sandy and the rainfall averages less than two inches in the year. Compare these conditions with those of any malarious town you know in India. The Ismailia experiment proves that the extirpation of mosquitoes to a degree sufficient to abolish malaria is possible, and so far it is a valuable lesson to Indian administrators, but surely it is futile to say that because success was achieved at Ismailia it should be achieved in the same manner in Indian towns. I have said nothing of the expense.

We may now turn to a place where operations against mosquitoes were less successful—Mian Mir. This cantonment was deliberately chosen by the Royal Society's Commissioners, to whom Captain James was attached as a representative of the Government of India, (1) because malaria was prevalent in it, and (2), because it was thought that the conditions for the destruction of mosquitoes were favourable. The Royal Society's Commissioners' experience in Africa had led them to doubt the practical value of operations against mosquitoes in the moister regions of the world, but they thought that such operations would be successful in the semi-desert conditions of Northern India. Mian Mir differs from Ismailia in most particulars, two of which are of special importance—the soil is impervious and the rainfall averages about 22 inches. The first year's (1902) operations were carried out by Captain James. His conclusion was that "mosquito destruction if it can be carried out successfully, will effectually banish malaria," and "the chief drawback to mosquito destruction is its difficulty and expense."

The second year's (1903) operations were carried on by Lieutenant Christophers. His conclusions were—

"The destruction of anopheles within an area by attacking their breeding places is extremely difficult. Although large numbers of pools were filled up and drained, and millions of larvæ destroyed by oil, adult anopheles were still abundant.

"The mere obliteration of local breeding-places is useless. In Mian Mir almost complete absence of breeding was ensured to a distance of over half a mile, but adults still appeared in large and increasing numbers in the area.

"A distinct effect was produced upon the malaria of troops and on the endemic index of the bazars. This was, however, only evident in the beginning of the fever season, and could not be maintained.

"The failure of the operations appeared to be due to the passage of adult anopheles into the area from without."

A great deal was learned from the operations in Mian Mir. Before they were undertaken it was thought that fever-carrying mosquitoes bred in still pools

of water, and could fly at most for a few hundred yards. It was discovered at Mian Mir that fever-carrying mosquitoes breed not only in pools, but in running water and that they can fly for half a mile; consequently such operations as can be carried out by a mosquito brigade were of very little use in Mian Mir. The critics of the operations did not, however, pause to consider matters of this kind, "Why," they said, "did you limit your operations to an area of four miles?" "What," they continued, "is the use of filling up and oiling puddles when there are channels of running water in which anopheles breed?"

It seems to me that this was hardly fair.

The second phase of the Mian Mir experiment began with the extensive works undertaken by the military authorities; the results obtained will, I hope, be fully examined elsewhere.

Before leaving Mian Mir there is one matter to which reference must be made. It has been said that the failure of the operations at Mian Mir has led to the neglect of anti-mosquito work in India. I do not think this is the case. All the Mian Mir experiments showed was that success in operations against mosquitoes is not so easily gained as some people say, and no one who reads the excellent reports by Major Ross on the work at Ismailia and by Captain James and Lieutenant Christophers on the work at Mian Mir will deny that this is correct. During the last ten years the energies of local Governments and municipalities have been very fully occupied in dealing with plague, and less money has been available for the prevention of malaria than might otherwise have been the case. But a great deal has been attempted. If we have erred in giving too much attention to quinine prophylaxis and too little attention to mosquito destruction, we have erred in the best company. Professor Angelo Celli of Rome, whose experience is greater than that of anyone else, at any rate in Europe, finds that, although the destruction of mosquitoes is possible in the laboratory and in small areas the difficulties in extensive areas are generally insurmountable.

Important information regarding malaria in villages was obtained by the Drainage Committee appointed by the Government of Bengal in 1906 to enquire into the conditions of the drainage of the Presidency Division and their connection with malaria. Captain Stewart and Lieutenant Proctor of the Indian Medical Service were the experts appointed to assist the Committee. In the districts of Jessore, Nudia and Murshidabad, they found that malaria as estimated from the spleen rates of children under 12 years of age, was, on an average, much less prevalent in villages situated on the banks of live rivers and on dry land than in villages situated on the banks of dead rivers or *bheels*, while in villages surrounded by thick jungle the spleen rate (68·8) was more than twice as high as that (26·2) in villages with little jungle around them—the effect of the thick jungle being to afford shade from the sun and check the evaporation of water from small hollows in which mosquitoes breed.

The success or failure of minor operations against mosquitoes appears to me to depend upon the state of the drainage. Where drainage is perfect, as in the case of Ismailia, the inhabitants can exterminate mosquitoes with little trouble; but where drainage is non-existent or bad, as at Mian Mir, it is practically impossible, by any means at present within their reach, for the inhabitants to destroy the mosquitoes.

In any scheme, then, which has for its object the removal of malaria from an area, the first step is to ascertain the condition of the drainage and, if it is imperfect, how it can be improved so as to prevent water-logging of the soil, not only in ordinary seasons, but in seasons of extraordinary rainfall. In the drier parts of India it seems it is abnormally heavy rainfall that is the danger. Last year in the west of the United Provinces the monsoon rainfall was about normal, but all the rain fell in two months, and fever was severely epidemic; in Berar the monsoon rainfall was 24 per cent. in excess, but it took nearly four months to fall, and fever was less prevalent than usual. Drainage schemes are costly and they require a long time to carry out even when the funds are available, and in the meantime the choice must often be made between measures against mosquitoes and the administration of quinine—unless, as may often be the case, it appears to be advantageous to use both these measures.

In making the choice all the circumstances of the case must be taken into consideration. To take extreme examples. If we have a town containing a few pools which are the only sources of the anopheles mosquitoes infecting the inhabitants, it is obvious that the remedy is to drain or fill up the pools. If we have a

small village surrounded by a swamp in which anopheles breed, it is evident that quinine prophylaxis is the best remedy. In India we have all the gradations between these two extremes, but those approximating to the village in the swamp are in the enormous majority.

An obstacle that has stood in the way of quinine prophylaxis is the doubt entertained by the general public and some members of the medical profession of its efficacy. This doubt is in most cases founded upon experience—medical men have found persons who have apparently been regularly taking quinine get fever, and most practitioners have come across cases in which quinine seemed to fail to cure malarial fever, while instances are not uncommon in which the results of quinine prophylaxis in a community have been exceedingly unsatisfactory. Sometimes the cause of failure is not far to seek—the drug has not been taken at all, the dose has been insufficient, or it has been taken irregularly. There are other instances, however, that are by no means easy to explain, and whoever has studied the recent researches into the fate of quinine in the animal body—of which Major James will give us a resumé—will recognize how thickly beset with difficulties the subject is and how great is the necessity for further research, particularly in this country which differs so widely from Europe in respect of the food of the people, metabolic changes and conditions of climate. It is possible that a race of malarial parasites that is immune to quinine may be developed. Fresh water amoebae may be gradually habituated to salt water, the infusorian *Stentor* kept in a weak solution of corrosive sublimate becomes tolerant of a solution containing four times the quantity of the poison that is fatal to stentors taken from pure water. Trypanosomes frequently develop in an animal being dosed with atoxyl, a race of trypanosomes that is immune to that drug, and they produce descendants in a new animal host which retain this immunity. Giemsa and v. Prowazek succeeded in obtaining races of *Colpidia* that could live in fairly strong solutions of quinine. The parasite of malaria is far more closely adapted to its normal surroundings than the protozoa I have mentioned, but it seems possible that quinine-fast plasmodia may be produced, and we may speculate regarding the nature of such an immunity and whether it would be retained after sexual reproduction and passage into a new human host. Persons infected with quinine-fast parasites would be in an unhappy position.

It appears, however, that the prejudice against the use of quinine as a prophylactic entertained by a few medical men is hardly logical. If it is admitted that quinine is *the* remedy for malarial fever and that it acts by killing the malarial organisms—propositions which few medical men will be found to deny, it is surely reasonable to believe that it will be as useful as a preventive as it is as a cure. When it is realized that it is fatal to the vegetative form of the parasite, but may be ineffectual against the sexual forms, it will be admitted that it is even more useful as a preventive than as a cure.

There is much evidence accumulated in this country to show that quinine swallowed regularly in sufficient doses is very nearly a complete preventive of malarial infection, or at any rate of the clinical manifestations of malarial fever. The most striking evidence of the kind is afforded by Colonel Braide's experiment in the Punjab in the autumn of 1908.

The use of quinine as a prophylactic was introduced into the Punjab jails many years ago by Colonel Bate, and its use in them has been continued with ever increasing stringency and success. Colonel Braide attempted an experiment on a great scale in 1907, but he failed to get his orders properly understood, and it was certainly fortunate that his great experiment was reserved for the autumn of 1908, almost the most malarious in the history of the Punjab. During the four months—August to November, 1908—every prisoner on admission to jail was given 10 grains of quinine in the presence of the medical superintendent, and thereafter received 15 grains once a week. The results were very remarkable. The admission rate from malaria, including in it the rate on account of "pyrexia of uncertain origin," was 173.5 per thousand, the lowest on record, and the malaria death rate of the year was the lowest with one exception. That this result was not contrived by classifying cases of malaria under some other disease heading is evident when the general admission rates from all diseases are studied. In 1908 this rate was 581.2 per thousand; in 1907 it was 706.8; and the mean of the five years ending with 1906 was 890.5. A success of this kind justifies a very critical examination of any reported failure.

I have laid stress upon the danger of comparing the statistics respecting the inmates of our prisons with the statistics of the general population, and I think it

would be just as unsafe to believe that because quinine prophylaxis may, with considerable difficulty, be made a complete success in prisons it will be equally successful among the people. The prisoners are under great advantages, their lives are regularly ordered, they are well housed, well fed, protected against the vicissitudes of the weather, and rarely undergo any exceptional bodily exertion. Quinine is given to them systematically in sufficient doses under supervision, and when they are attacked by fever every means is used to ensure the quinine acting at an advantage. Among the general public many know that quinine is a remedy for malarial fever and are eager to get it when they are suffering, but many are prejudiced against it, and probably the majority have never heard of it. We shall therefore have to take means to bring the advantages of quinine before all those who live in malarious places, and not only eradicate prejudices, but educate the people to use the quinine in sufficient quantity and at the right time. I fear these will prove to be very hard tasks.

The best preparations for the use of adults and children will have to be selected; and probably much will depend upon the way in which the drug is dispensed.

The correct dose must be determined, and I think it would be of advantage to issue the drug in tabloids or powders equal to the minimum dose sufficient for prophylactic purposes, with directions that the single dose should be repeated a certain number of times at specified intervals as a cure.

It is essential, I think, that it should be recognised that the distribution of quinine cannot be made self-supporting, and in view of economy, if for no other reason, very careful enquiries will be necessary regarding the needs of different localities. In many places no quinine is necessary at all; in others it is required only for a short time in certain years; in others it is required every year, but only at a certain season, and in yet others there is need for its continuous use.

It is clear, therefore, if we are adequately to carry out the distribution of quinine on a great scale, that special provincial agencies will have to be established for the work. The distribution of quinine is one of the questions with which this Conference is specially to deal, so that it is not necessary to do more than mention some of the more important matters to be settled.

Although our knowledge of the etiology of malaria and its treatment is fairly extensive, it is still wanting in continuity and completeness, and the scientific study of its epidemiology is only beginning. Some of the gaps in our knowledge regarding the possibilities in the life cycle of the parasite must be filled before we can hope to master the epidemiology of the disease to which it gives rise, and we cannot devise the simplest and best preventive measures until the epidemiology is thoroughly understood. As I have endeavoured to indicate, we have little exact knowledge of the distribution of malaria in the country, of the local conditions which favour it, and of the best means to render these causes inoperative. I think the time has come when we should establish a permanent organisation for dealing with malaria in India.

It will be evident that the defects in our knowledge may be classified as follows :—

- (a) Questions of administration, *e.g.*, the best agency for the distribution of quinine.
- (b) Questions that can be solved by experts on the spot, *e.g.*, the causes of disease and death and the distribution of malaria in a district; and
- (c) Questions that can be solved only by highly trained experts with the resources of a well-appointed laboratory at their disposal.

The organisation I would propose is the following :—

I. A Committee in each province of three or more members personally interested in the malaria problem, enjoying the confidence of the local Government and prepared to obtain information and supervise local enquiries. They should, perhaps, control the agency for the distribution of quinine. One of their first duties would be (in association with the provincial Sanitary Department) to ascertain the real causes of death in different localities, and to set in motion an enquiry in each district regarding the relation of the fever season to the drainage and rainfall.

II. Every autumn each provincial committee would delegate, under the orders of the local Government, one of their members to attend a meeting of a General Committee in Simla. This General Committee would consist of the provincial delegates, the Sanitary Commissioner representing the Government of India with Major James as Secretary.

III. The Government of India would appoint a Scientific Committee consisting of Lieutenant-Colonel Semple, Major James (Secretary), Captain Christophers and the Sanitary Commissioner, with power to add to their numbers.

A certain number of workers would be entertained under the Scientific Committee, and, when necessary, workers might be deputed to serve under the provincial Committees. Such workers during the time of their deputation would, of course, be under the control of the local Committee, but, in order that the purpose of the whole organisation should not be defeated, relations of mutual confidence would exist between the central and local Committees, and there would be free interchange of views, not only on the occasions of the annual meeting, but by means of correspondence at all times.

His Honour the Lieutenant-Governor of the Punjab made the following speech :—

On behalf of the Punjab, and perhaps I may venture to say on behalf of all the local Governments, I thank Your Excellency and Your Excellency's Government for having summoned this influential Conference to deal with what is perhaps the most important sanitary and administrative question in India. In view of the numerous experts in medical service and administration and the Indian gentlemen here assembled we may hope with some confidence that the vital problems mentioned in Colonel Leslie's able paper will receive the fullest consideration and that a solution of some at least of our difficulties may be found.

The Punjab has bulked largely in Colonel Leslie's paper, and perhaps as the head of this Province I may be allowed to add a few words on the general question before the Conference proceeds to attack it in detail. It is a curious fact that in the Punjab when we are involved in epidemic disease the results are ordinarily more strikingly disastrous than elsewhere. This holds good especially in the case of malarial fever. It has been my good fortune to have spent most of my service amongst the people as a district and settlement officer and I can speak with full knowledge of the terrible ravages that malaria causes. Epidemics of small-pox, cholera, and plague, are grievous afflictions but neither singly nor even collectively are they responsible for so much economic inefficiency and what is worse actual human misery as the recurrent scourge of malaria. To cope adequately with this curse of the country has been my chief endeavour since I assumed charge of this Government. Colonel Bate and Colonel Braide will explain what measures the Punjab Government has adopted and how far they have been successful. I am confident that the results of the deliberations of this Conference will materially help me in my task. It is a curious fact that most of the severe epidemics of malaria in recent years in the Punjab with which I have been brought into personal contact have been associated with a cataclysmal downpour of rain in the months of July and August, and it is perhaps a still more curious fact that the epidemic has almost synchronised with the downpour, as Colonel Leslie has noticed. I remember the heavy rains of 1880 and the resultant epidemic in Amritsar when that unfortunate City lost 15,000 people in three months from malaria. In 1890 there was heavy rainfall in the Punjab submontane, and the high uplands of the Gujrat, Sialkot and Gurdaspur districts were decimated. This tract is singularly dry and free from stagnant ponds and no doubt the question why fever should have visited it in such a way, will be duly considered. In 1892 I was in Peshawar. It was thought that the dreaded Peshawar fever had died out owing to sanitary improvements and the introduction of a pure water supply. In July and August of that year we had 20 inches of rain against an average of perhaps two and this was followed by an appalling out-break of the worst type of Peshawar fever, and the returns of the Army will show how the troops suffered. Our experience of last year has been noticed by Colonel Leslie, but it was very similar. I venture therefore to suggest for your consideration, gentlemen, why these out-breaks follow so closely upon these downpours. There must be other causes than those mentioned by Colonel Leslie, and if you can discover them you will have done well indeed by the Punjab.

I will conclude my remarks by again thanking Your Excellency for your gracious action in convening this Conference from which we all hope so much for the country and its peoples.

The Conference then adjourned.

SECOND DAY.

Wednesday, October 13, 1909.

The Honourable Sir Herbert Risley, K.C.I.E., C.S.I., I.C.S., President.

The President: I should like to say a word or two about arrangement and procedure. As to arrangement we have grouped the representatives of the various provinces together so that they can consult and concert their attack upon the reader of the paper. As to procedure, first of all the paper will be read, and I should like to say here that I propose to curtail the reading so that as much of the actual time as possible can be devoted to discussion. This is in accordance with the practice in England. The British Association, for example, allow ten minutes which they as a favour extend to a quarter of an hour. I think that is reasonable; what we want to get is as much discussion as possible and we desire to waste as little time on the mere reading of papers already printed as is possible. After the paper has been read I propose that there should be a full discussion of the proposals made. That is what we want to get at. We know the scientific doctrine and want to bring the experience of the representatives of the various provinces to bear as to the way in which this or that proposal can be given effect to. I shall take notes of the discussion to the best of my ability and shall then endeavour to formulate a provisional conclusion expressing the sense of the Conference. I have no doubt that on the last day when we put the provisional conclusions together we may find it necessary to modify and adapt a little so that the conclusions may accord with each other and be arranged in a connected manner.

The following paper was then read:—

*Remarks introducing a discussion upon the distribution of Malaria in India by
Major S. P. James, I.M.S.*

I have been asked to introduce the discussion upon the distribution of malaria in India, but as this important subject can be dealt with adequately only by those who have personal knowledge of many localities in each province, my remarks will be as few as possible. The object of ascertaining the distribution of malaria accurately and definitely is that we may be able to state in what parts of the country measures are advisable, in what parts they are essential, and in what parts they are not only essential but urgent. Every province—and possibly every district of every province—contains areas that are highly malarious and areas that are not at all so, and before we begin to consider the particular kinds of anti-malarial measures to be adopted, we must, by mapping out those areas, obtain exact knowledge of the magnitude of the task that lies before us. Upon this knowledge may depend entirely the decision in regard to the measures that will be undertaken. It is obvious, for example, that if a province were so fortunate as to possess only a few highly malarious areas it might be possible, by concentrating the resources of the province on those areas, to undertake and bring to a successful issue much more radical schemes than could be entertained in a province where, on account of the disease being almost everywhere prevalent, funds and effort are required in numerous areas. I think this truth is not sufficiently recognised. Many people still believe that anti-malarial measures are required almost everywhere in India and that for this reason the magnitude of the task is to be measured only by the area of the country and the number of the inhabitants. There are still people who go to the trouble of working out the cost of distributing quinine to the whole population of a province. Such calculations serve no useful purpose and the appalling figures which result from them tend to discourage effort. But if instead of proceeding to ascertain the magnitude of the task by such methods, an attempt were made in the first place to define the exact distribution and comparative prevalence of malaria in the province, the result might quite possibly show that the expense of dealing with the disease would be only moderate in comparison with the total revenues of the province. For example, even a cursory examination of the death-rates from fevers in the Madras Presidency indicates that the areas in which measures are urgently

required cannot be numerous and that the task of dealing sufficiently with malaria in this Presidency may be by no means one of great magnitude. Indeed, if we assume that at any rate for a number of years all our efforts should be concentrated upon the mitigation of malaria in places where such efforts are urgently required—and I take it that this means in places where the disease is seriously interfering with prosperity and with the natural increase of population—I doubt if there are half a dozen considerable areas in the Madras Presidency which would come in that category. Again it is, or was until quite recently, a common belief that Assam as a whole is intensely malarious, but the truth is that a great part of that country is only very slightly malarious, and that in some areas the disease does not occur. I believe that the same may be true even of a country with so bad a reputation for malaria as Burma. It is true also of such small sub-divisions as districts and even of cities and towns; it often happens that only parts of these places are highly malarious. It is therefore unfortunate that even at the present day one can give a number of instances in which, owing to lack of exact knowledge of the distribution and comparative prevalence of the disease, money and energy are being wasted upon areas where malaria is so slightly prevalent as to call for no special measures. It will now be clear why I stated in the beginning of my remarks that the distribution of malaria in India can be dealt with adequately only by those who possess intimate local knowledge. When the subject was decided upon for discussion at this Conference it was hoped that time would permit the collection and compilation of statistics that might afford at any rate some useful general indications for guidance in regard to the parts of India where measures against malaria are most necessary, but it was clear that the areas for which statistics are compiled in the central offices of the Government of India are necessarily so large that no results based upon them would provide information that could be regarded as of much value for the purpose mentioned. And indeed, I think, I am correct in saying that owing to the very unequal distribution of malaria, no statistics are of much value for that purpose except such as relate to much smaller areas than those for which any figures are at present anywhere published. Captain Christophers will deal with this aspect of the problem and will show what misleading results may be arrived at unless the principle of working upon the statistics of small areas is followed. Colonel King also will doubtless tell us that whereas in the Madras Presidency, if we were to deal with the statistics of the province as a whole or even with those of districts, we might conclude that no measures against malaria are urgently required, we have only to consider the statistics of small areas to realise how necessary such measures are in certain tracts. I think, then, that this is the first principle to adopt in an endeavour to state the distribution of malaria in India, and I venture to submit to the Conference that an investigation similar to that which Captain Christophers has made in the Punjab should be begun in every province.

The only other subject to which I desire to refer is the necessity of ascertaining, for as many areas as possible in each province, what proportion of the deaths recorded under the heading fever by the existing agency for the collection of vital statistics is due to malaria. From a recent issue of the "British Medical Journal" I see that even at meetings of learned bodies in England the well-worn phrase, "few of us realise that in India alone nearly five million lives are the annual tribute exacted by malarial fever," is still called into service when occasion offers, and the fact that a statement so incorrect still gains credence is in itself sufficient reason for enquiry to establish the extent to which it is erroneous. A more important reason is that in the absence of local investigations by skilled workers such enquiries are an essential preliminary to any attempt to state the distribution and prevalence of malaria. The Sanitary Commissioner with the Government of India told us yesterday that for India as a whole about 20 to 25 per cent. of the deaths recorded as due to fever might reasonably be considered as being caused by malaria. But it is obvious that while this is an accurate estimate for India as a whole, it is less accurate for the different provinces considered separately and much less accurate for many smaller areas. So far as I am aware Bengal and the United Provinces are the only parts of India in which systematic enquiries on the subject have been instituted and an examination of the results of those enquiries shows that in future certain errors incidental to pioneer investigations might be avoided. I submit, then, that the necessity of carrying out a number of enquiries of this nature is a subject well worthy of discussion, and that among other details an attempt should be made to decide the number of such enquiries that are advisable in each province, the staff requisite for

their conduction, the duration of the enquiry in each area, and the chief points to which prominence should be given in any instructions drawn up for the guidance of officers in charge of them. When used upon the working basis of the statistics collected by existing agencies, the knowledge derived from a series of careful enquiries by a professional agency in selected areas of every province would be of very great service in an attempt to ascertain the areas in which measures to mitigate malaria are urgently required.

The following discussion ensued:—

Colonel Lukis: Two points have been raised by Major James in his paper, the first may very well be left over until Captain Christophers has read his paper, because that will give us a much more complete idea of what action is necessary in order that we may ascertain the most malarial districts. I agree with Major James that it is necessary for those who deal with a subject of this nature to possess local knowledge, and therefore I hope that the various delegates who are present to-day will state their views as regards the unequal distribution of malaria to which Major James has drawn attention. On the point in his paper as to the necessity of an accurate diagnosis with a view of arriving at correct figures as to how much of our fever mortality is due to malaria, I agree with what he says, for, although 25 per cent. may be taken as a general average it must vary very greatly in different areas, and I am quite sure that in certain parts of the country there are diseases which very largely mask the proportion of the death-rate that is due to malaria. It must be remembered that under the head of fevers we have to include not only malaria and *kala azar*, but enteric fever, Malta fever, and in some parts of the country relapsing fever, dengue, and a very large number of cases of septicæmia. I think, therefore, that a careful investigation is necessary in the different parts of this country and that this investigation might be undertaken on the same lines as the investigation made last year in Bengal. Possibly the Bengal delegates may be able to give us some information regarding that investigation.

Colonel King thought that the presence of malaria must depend on certain physical conditions and that therefore the only question that remained was, given a malarious area, was the intensity of the disease always the same or did it vary from time to time? He thought it would vary under seasonal conditions and especially when the conditions were such as to alter the level of the subsoil water. He agreed with Major James regarding the question of localisation, and it was the most important point which the Conference had to consider. He agreed also with Major James that in the Madras Presidency and also in Burma the localisation of malaria is very marked. He then referred to the question of Registration. It was well known that this was a difficult point. As regards the remark that in future certain errors, incidental to pioneer investigations might be avoided, Major James had probably in mind the employment of special experts; his own view was that each province should depend upon itself as much as possible for its investigations; there were certain conditions which required expert knowledge, but for ordinary routine work every province should have an organized agency, one capable of taking up the question of malaria systematically and continuously.

Major Donovan wished to know more about the investigations carried out by Captain Christophers.

The President said localization was easy to understand. In the district in which he served some years ago there were three areas, the alluvial, laterite and coast. In the first Burdwan fever was raging, in the laterite there was no fever, in the coast there was fever only during the rains. Obviously statistics of the whole district would throw no light on the state of things. What it was necessary to know was what was to be the methods of investigation and what was to be the agency for carrying it out. Was it to be the Civil Surgeon, or the Sanitary Commissioner and his staff, or was it to be done by special officers. The question of cost would come in and would have to be looked to.

Major James, referring to Colonel King's remarks, said that there had been some misunderstanding. The object of his remarks was to show that they must not begin the discussion of particular kinds of measures to be taken against malaria until they had made some arrangements for determining the distribution and relative

prevalence of the disease. In his paper he had drawn attention to two quite distinct subjects in regard to which arrangements for investigation were required.

Colonel King said that he did not think he had misunderstood Major James. It was, he thought, not necessary in each province to send out a man to ascertain where malaria was; this was known. And it was only when the provinces were in difficulties that they would need the assistance of experts.

Captain Christophers then read the following paper. He illustrated some of the points by a reference to diagrams:—

A new statistical method of mapping epidemic disease in India, with special reference to the mapping of epidemic Malaria by Captain S. R. Christophers, I.M.S.

The accuracy and value of mortality statistics in India is often questioned. In the present paper I hope to be able to show that in spite of this frequently expressed doubt as to their value they may be, at least in some cases, an extremely valuable aid in the study of epidemiology, notably in regard to the distribution of epidemic disease.

Obviously the objection as to accuracy is very important and it requires no intimate knowledge of Indian conditions to realise that in greater or less degree the objection is justified by fact.

In regard to the value of the returns there are, however, two distinct questions involved which it is necessary to avoid confusing with each other.

- (1) There is the question as to the degree of accuracy with which the mere fact of death is recorded.
- (2) There is the question as to the correct diagnosis of the cause of death.

We should not let doubt as to the value of the second of these points influence us in regard to the first, or rely upon the second because we believe the first to be approximately accurate.

It will perhaps clear away some possible misconception regarding any attitude to these figures if I at once confess that, for reasons I shall give later, I have no intention of relying upon diagnosis as entered in the returns and that an error of even so much as 25 per cent. in the number of recorded deaths will not seriously interfere with the application of the method of using these returns I am about to describe. Even grosser default in the registration will not altogether prevent the application of this method, though it will no doubt affect the value of the results obtained.

Before going further it is necessary to note very briefly what mortality figures are available and the conditions under which they are collected. In doing so I shall confine myself to a discussion of the returns of the Punjab, which so far are the only ones I have investigated in sufficient detail to enable me to speak.

Two series of mortality figures are collected, namely, (1) those from towns sufficiently large to possess municipal arrangements, and (2) those from rural areas. In the case of towns the registration of deaths is conducted on various lines. For example, in Amritsar deaths are recorded by the return to a Registrar of Births and Deaths of the permits given to persons burying relations in the different cemeteries which surround the city. The system so far as I have been able to judge is conscientiously carried out; and the fact that the city is so densely populated makes it improbable that many burials take place outside cemeteries. Those who are familiar with the conditions would allow, I believe, only a small error, say, 5 per cent., as regards the total number of deaths recorded.

If we can rely upon the figures to this extent we have a very valuable asset in the Amritsar figures in studying the mortality from epidemic malaria, the more so since the particulars regarding age, locality in which the death has taken place, &c., are with the rarest exceptions recorded. In Amritsar, unfortunately, an immediate use of the statistics as applied to locality is impossible since the areas known as "Divisions," of which the populations are known, are not separately recorded, whilst the "Katrass," which are the units used, are areas of which the population is unknown. Nevertheless the material facts are all recorded though their application is only possible at the cost of some labour. The value of the results that may be obtained from such figures are evident from some maps of Amritsar I am showing you in which the history of the epidemic malaria of 1908 can be very clearly traced.

In Delhi deaths are recorded separately for the different wards, and of these the population is known so that the records are available at once to give valuable information, even allowing, as we are willing to do, an error of, say, 25 per cent.

On the contrary, in Lahore the particulars of registration do not include the locality in which the death has occurred and the information regarding deaths is useless except as regards the city as a whole. In the smaller cities again some have, so far as one can judge, well maintained systems of registration, others much inferior ones. But we may, I think, take it for granted that matters are rarely so defective as to entail an error of 25 per cent., an error which we have already stated need not deter us from making use of the figures in the ways I shall indicate.

The second series of returns, namely, those from rural areas, are collected in the following way. In each village there is a *chowkidar* whose business it is to record in one book the deaths and in another the births taking place in the village. At various times these books are brought by the *chowkidar* to the police station of the *thana* in which the village is situated, and all entries are copied out into the general register of deaths kept by the police. At the end of the month the deaths recorded in each *thana* are totalled and sent to the Civil Surgeon of the district, who collects the different *thana* figures in a monthly statement which he forwards to the Sanitary Commissioner. It is these figures totalled for the "Districts" by the Sanitary Commissioner which are published for rural areas.

But districts are very large units, often exhibiting considerable diversity of physical features in their various parts; they have, often enough, areas in which an epidemic has occurred and others in which there has been no epidemic. The result is that in the total figures epidemic rises tend to be obscured, the more so the larger the area to which the statistics refer, as for example, when the figures for a number of districts are grouped together. To show how this comes about, we may take, as an example, the returns for Delhi in 1908. If we look to the total figures for the city given week by week we get a curve as shown in the accompanying figure, a curve which shows a somewhat indefinite and not very high rise during the period of epidemic malaria. But if we now deal with the components from which the total figures are obtained, that is the figures for the separate wards of the city, we get in some very high epidemic curves, as for example, in Ward I, comparable with those of the worst affected areas in the Punjab, whilst in others we see only extremely modified epidemic curves, the wards in this case having, for reasons we need not enter into here, been comparatively free from the epidemic. We see clearly, in fact, that by the act of including the figures for various areas of different characters in our total we have obscured facts very clearly shown if we study these figures separately.

Again, when we use figures for the whole year we tend to dilute, as it were, and so either partially or wholly obscure an increased death-rate due to epidemics lasting a short time.

By separating the figures into those relating to the different months and into those for the different *thanas* we greatly accentuate any facts shown by returns.

Leaving for the present therefore any consideration of annual district totals, let us examine with a view to their utilisation, statistics for the *thanas*. The statistics relating to towns we shall not further discuss in this paper, though these are well worthy of study and afford most interesting information in regard to epidemic disease.

The first thing we shall notice in a series of monthly *thana* figures is that in the absence of epidemic disease the number of deaths exhibits a very moderate amount of variation.

It is different the moment epidemic disease makes its presence felt. We then have rises in the line of a very noticeable kind, as for example, in the curve given where cholera was epidemic in a *thana* (Nurpur). Turning our attention to such rises in the total death-rates we shall find that each rise is associated with the record of some epidemic disease. A further examination shows that there are four diseases commonly concerned in these rises of the total death-rate, namely, plague, cholera, small-pox, and malaria; of these plague and malaria stand consistently pre-eminent. If we further examine numbers of *thana* records we find that the epidemic rise from each of these diseases tends to occupy a certain definite portion of the year. Plague shows a rise, generally in the first half of the year; malaria very consistently causes a rise in the months of September to December; cholera with considerable uniformity is the cause of any rise in July or August. Small-pox

exhibits more impartiality in its distribution throughout the year, but like plague is more often epidemic in the spring than in the autumn. The different diseases also often exhibit very characteristic epidemic curves. Cholera gives a short sharp rise, small-pox a long curve not usually of any great height. Malaria especially gives a very characteristic curve rising sharply to its full height in October, remaining high for November and perhaps December, and falling gradually throughout the early months of the year.

Even if one has no information regarding the disease concerned in the epidemic, it is possible nearly always to make a correct diagnosis from this seasonal occurrence and other features of the curve, just as one may diagnose some disease by means of a temperature chart.

The important point, however, in our present connection is that we are justified in assigning the increase in deaths during any particular rise to the disease then epidemic, though, of course, cases occur where the effect of two diseases overlap or perhaps run concurrently. In the first case we can generally see what is happening; and the second eventuality is sufficiently rare not to be a serious cause of error.

If we can rely upon the total number of deaths being approximately accurately recorded we can therefore almost afford to neglect the question of correct diagnosis. One is the more satisfied in doing this from the following considerations.

If we take a rise of deaths associated, let us say, with the presence of epidemic plague, we do not find that deaths recorded as due to plague are necessarily sufficient to make up the entire extra mortality that has given us the rise in the curve. A moment's thought will show us what is happening; it is that many cases really plague or indirectly due to plague are not diagnosed as this disease. In the case of cholera we often find cases recorded from villages near head-quarters are returned as cholera, but those from outlying and remote villages as some other disease; yet the increase of deaths in both alike justifies us in saying that cholera was the cause of the high mortality in each. The epidemic curve in fact is often a more reliable guide to the mortality from epidemics than the diagnosis given in the death returns. In the accompanying chart of deaths in Nurpur during the years 1903 to 1906 a small rise is seen. According to the returns this is due to an increased death-rate from fevers. From its position we should suspect the rise to be due to cholera, and as a matter of fact we find that deaths from cholera at this time are recorded in nearly all the *thanas* of the district. We can safely conclude that though not seriously affected Nurpur suffered to a certain extent from the cholera epidemic.

Again, whilst dealing with total death-rates we are dealing with actual facts. But once we take note of "diagnosis" we deal with conclusions only, conclusions more or less true or untrue. And it is not only that diagnosis by an ignorant *chowkidar* is apt to lead us astray; but that the diagnosis even of expert medical men may in some cases lead us into error. If we actually investigate conditions, for example, where we know malaria to be causing a heavy mortality, we at once meet with cases that the pathologist perhaps recognises to be primarily malarial, but which can quite correctly be returned as dysentery, pneumonia, bronchitis, and so on; the ignorant *chowkidar* who returns all as fever in such a case may give a truer picture than the expert clinician who returns us perhaps in many cases the actual cause of death.

It is not necessary then to demand as a first essential to a study of disease by mortality statistics that all deaths should be correctly diagnosed. It is even possible that apart from epidemic disease the effect of different diseases upon the death-rate may eventually be better determined in India by the investigation of sample villages and areas and proportionate allowance made in the total figures, than to hope for such an impossible triumph as an invariably correct diagnosis of the cause of death.

Such remarks are especially applicable to malaria, the diagnosis of which is recognised to be in many cases difficult. If we chart out for each month in any given area the number of deaths from "fevers" we shall find that whereas throughout the year in the non-epidemic periods there is an approximately even distribution of deaths under this heading, there is in the autumn the epidemic increase we have already referred to. If we take a number of years we shall see that whilst the deaths returned as "fevers" during the non-epidemic periods keep approximately

the same, the death-rates of the epidemic periods vary enormously from year to year.

Let us take, for example, the monthly deaths from fevers in the Shahpur District. We shall see that year by year, except during the period of epidemic malaria, the deaths from fevers maintain so constant a figure that they scarcely ever drop below 500 or rise above 700 in the month. Deaths from non-epidemic fevers in this district therefore may be taken to number about 7,000 per annum. The excess in any year over this is demonstrably due to the autumn epidemic of malaria. The extra deaths vary from 1,000 to as many as 20,000.

With these preliminary remarks upon the statistics in general let us turn our attention to methods of utilising these statistics in the mapping out of epidemic diseases.

We may summarise our remarks by saying that when an epidemic disease makes its appearance in a *thana* its effects are clearly seen in the form of a rise in the death curve. Examples of such rises are constantly occurring as we follow the death figures of any particular *thana*. If we refer to the figures for surrounding *thanas* we find as a rule these same rises repeated, showing that the *thanas* were all more or less simultaneously affected. But as we pass away from severely affected areas the epidemic curve becomes smaller or may cease to be apparent. An epidemic rise, for instance, such as is shown in the curve for Kot Momon in comparison with such epidemic rises as will be described later, is quite insignificant, but it serves to show how even in its minor manifestations epidemic mortality betrays itself.

In tracing out then the distribution of an epidemic we can note its presence or absence in any particular *thana*. Not only so, but whilst in some *thanas* the height of the epidemic rise shows that the epidemic was severe, in others it tells us that the effects were slight. We can in fact not only map out the extent but also the varying intensity of the epidemic over any area we wish. All we require is a figure to indicate in each case the height of the epidemic curve. Such a figure may be the death-rate per mille during the epidemic time compared with the average death-rate in non-epidemic periods. But we may measure the epidemic intensity in an even simpler manner by using what I shall call an epidemic figure. This figure I obtained by dividing the number of deaths during a given period during the height of the epidemic by a figure representing the average number of deaths in a similar period free from any epidemic disease.

In the case of malaria I have made use of deaths during October and an average of five years July deaths, respectively, this latter month being convenient since it is not liable to epidemics of plague or malaria. But in studying the distribution of epidemics we may take the figure for any other month we may wish or use any other standard of average death-rates provided we use the same method throughout. As so obtained the figure is simply a ready way of indicating the height of an epidemic rise.

As an example of the use of this figure let us take four *thanas* in the Shahpur District, Bhera, Shahpur, Bhalwal, and Kot Momon. Confining our attention to the latter months of the year 1908 we have in Shahpur a rise about five times higher than the normal, in Kot Momon the rise is not more than twice, whilst in Bhalwal it is about three times the normal. In Bhera, however, we see that the epidemic curve rises to at least twenty times the normal.

If we now take other *thanas* in this district and give to each its epidemic figure, which you will remember is simply a figure representing the height of the epidemic rise, we shall find that we are mapping out an epidemic having its greatest intensity in the Bhera *thana* and fading in intensity as we pass to the west and south.

In a similar manner we can apply this method readily to the whole Punjab and we find that instead of vague ideas we get the most definite information regarding the distribution of the 1908 epidemic.

In a similar manner also we can not only map out this epidemic, but we can go back as far as our figures are available and map out epidemic malaria in any year we wish. The peculiarities of the different epidemics which have ravaged the Punjab I shall refer to in another paper; but I may point out how remarkable are the facts brought out in the series of maps I am showing you.

So far we have used *thana* returns. But in dealing with such great and widespread epidemics as those we have described we may use even district returns with advantage. But the results as shown in the accompanying map fail to give us many of the more interesting features of the distribution shown by the *thana* figures, as for

example, the long tongues of epidemic malaria in 1908 extending down some of the riverian tracts. More interesting are the results obtained from further subdividing the *thana* records.

Although not available except in the village *chowkidar*'s books or in the general register in the particular *thana* concerned, we can, if we visit the *thana*, obtain statistics for individual villages. But the number of deaths now being much smaller we cannot treat our figures so rigidly as those relating to the *thanas*. Nevertheless, we can obtain very definite evidence regarding the extent to which any particular village suffered, and we can map out again in greater detail any particular *thana*.

The accompanying figure gives a plan of Shahpur *thana* worked out in epidemic figures for October, 1908. The distribution of malaria shown by this method was found to correspond with remarkable exactness to that indicated by an examination of the spleen rate and other indications as to the effect of the 1908 epidemic. A similar correspondence was shown in Bhera, Bhalwal, Kot Momon, Gujrat and other *thanas*.

By utilising in this way village death returns, one can therefore in a single day map out the distribution of epidemic malaria over an area which it would take weeks to explore thoroughly.

Another use to which this method can be put is to map out the history of an epidemic month by month as I have done in the maps of Amritsar I have shown.

Briefly then I may summarise my paper by saying that the mortality statistics of the Punjab are capable of telling us a great deal regarding the incidence of epidemic disease.

That in arriving at this information the method of using an epidemic figure has its uses.

In the case of great epidemics we can gain a rough notion of their distribution even from applying this method to district totals. But to ascertain with any delicacy the distribution of these epidemics, it is necessary, for reasons we have explained, to resort to *thana* figures, or even for certain purposes, to the returns of individual villages.

The following discussion ensued :—

Mr. Nathan said he would like to have some definite idea of the manner in which each province was to obtain accurate vital statistics. He took it that they were to find out for each province the relative intensity of malaria in the different parts by the use of the general statistics, and having done so, would require to find out by more detailed investigation what portion was due actually to malaria. Were they to take sample areas in different parts of the province and on what sort of scale in order to correct the figures of the province as a whole? Then did they require a separate set of investigations for the particular measures required for these malarial area?

Mr. Ferard said that a special officer, Major Robertson, I.M.S., had been put on in the United Provinces, and described what his duties were. The special officer worked in the most malarious part of the province.

Mr. Nathan asked whether the special investigation would have to be on a very large scale and in many places.

The President understood that if it was decided that special investigations were necessary, the methods of enquiry indicated by the progress of science up to date showed that expert officers would be required. The officers would be required to work in accordance with the latest methods of research and he presumed selected areas would be taken. He thought it was desirable that the Conference should come to some conclusion on this question and on the question of selected areas; they were pretty big questions.

Colonel King said that in the first place there was a large amount of local experience to go upon. In respect of statistics, anything above a certain rate would arrest the attention of the Sanitary Commissioner and of the Civil Surgeon of the district. Speaking broadly, he thought Captain Christophers's paper represented the difficulties which existed under the present system, and Captain Christophers had brought forward a very ingenious method of dealing with them. The paper represented the results of a resurrection of old statistics. What was now required was living results. If there were in each province an organised sanitary service, would it be necessary to take old statistics and take a rough rate for this and for that? He thought not. If there were a sanitary service it would be possible to say in certain

circumstances what was occurring, and the sanitary officers would go to the spot at once and advise. Captain Christophers's paper had shown, among other things, that registration is defective. He repeated his suggestions as regards the sanitary service.

Colonel Leslie said that Captain Christophers's paper dealt with a method of investigating epidemic malaria in the provinces, and one of Major James's proposals was for checking the every day returns of *chowkidars*. The two subjects should be kept distinct. In regard to the proposal for checking existing vital statistics, he said that the accuracy of registration varied very much in different parts of India, perhaps it was best in the Punjab and worst in Madras; what it was necessary to know was how far these *chowkidars'* figures were correct. The causes of death were inaccurately given. Some time ago he made a proposal that certain areas should be selected in each province, and there medical men should be sent who would go over the whole of these little areas and enquire into every birth and death, register the actual number of births, still-births, deaths and the causes of death. This had been done in Bengal. If enquiries were carried out carefully it would be possible to get a good idea of what takes place from day to day in the selected areas, and the results would form a key by which the statistics of the whole province could be interpreted. In the area of enquiry in Bengal the deaths from fever were given at 65 per cent. of the total deaths, but by enquiry it was found that phthisis, pneumonia, kidney complaints, and many other diseases were included under the heading fever. It was calculated that the true deaths from fever were 25 to 35 per cent. of the deaths recorded under that heading. It was thus shown that in regard to diagnosis the every-day statistics which the people themselves collect are entirely wrong, and we now desire by special enquiries in each province to obtain some standard figures by which those statistics may be interpreted.

The following paper was then read—

Malaria in the Central Provinces, by Major W. H. Kenrick, I.M.S.

The Central Provinces has not suffered from malaria to the same extent as some of the other provinces; the average death-rate from "fevers" for the ten years from 1898 to 1907 was 17 per 1,000 of population.

If, as suggested by the Sanitary Commissioner with the Government of India, we should consider 25 per cent. of these deaths as due to malaria, it means that about 51,000 persons annually die of this disease in the Central Provinces.

Since 1897, when the fever mortality reached 40.9 per 1,000, malaria has not assumed an epidemic form. Although there was some increase in 1908, there was nothing approaching the severe epidemic experienced in the Northern Provinces.

The varieties of fever most commonly met with are the benign tertian and the malignant tertian forms. It is noteworthy that the latter type is more often met with in association with forests and low-lying land near jungle hills, and as a very large portion of the Central Provinces is reserved forest, much of the malaria met with is characterised by fever of a remittent nature with a tendency to relapses, and chronic enlargement of the spleen.

Typical cases of benign tertian are met with more especially in Europeans and susceptible new-comers to the country, but with natives of the province the malignant tertian is the variety that most frequently comes to notice.

In the jails and police hospitals most of the cases of malaria are relapse cases. The jail statistics, however, are occasionally misleading, by the inclusion of many cases of "Spirochæte fever" under the heading of malaria; it is only by the diligent microscopical search of a blood specimen that these can be differentiated with any certainty.

The great majority of malaria cases, especially those of a severe or persistent type of fever, give a history of having acquired the infection while in the district away from the headquarter town.

A European is called upon to leave his headquarters on a short tour of duty; he spends a few nights in a certain dak bungalow or rest-house, and within three weeks of his return he develops an attack of fever. With natives it is generally the result of stopping the night at some "*parao*" or rest camp, or at some village *dharm-sala*, while on a journey to or from his home. This is the usual cause of the attack of malaria; very few cases are of indigenous infection.

A continual importation of malaria takes place from the highly-infected rest-camps and halting-places on the main lines of traffic into the headquarter towns.

There is always a certain amount of malaria of local origin in most towns, but this affects mainly children and new-comers; it is probable that adults sometimes acquire a certain measure of immunity to local infection, but are not immune to the more virulent type found at certain places in the interior of the districts. As is the case elsewhere the infection readily yields to treatment, if thorough.

For simple cases of benign tertian and mild attacks of malignant tertian, a purge, followed by 15 grains of quinine, in solution, twice a day, for five or six days, suffices.

For the severer forms, especially cases of remittent fever in natives, who often object to single large doses of quinine, I have found a dose of 2 grains, every hour during the day and occasionally at night, if necessary, most efficacious.

By this means the dose can be regulated to a nicety, the administration being withheld so long as symptoms of cinchonism persist.

A high remittent fever which has lasted some time will often readily yield within 48 hours to this treatment.

With regard to the hyperdermic administration of quinine (intra-muscular rather than subcutaneous) for pernicious attacks, I have found no ill-effects resulting from the bihydrochloride salt. On the other hand, upon two occasions the use of the bisulphate salt has been followed by a small circumscribed slough.

For malarial cachexia and chronic fever, quinine should be supplemented by large doses of Epsom salts, the latter having a marked action in setting free the parasites in the blood stream, and thereby bringing them under the influence of the quinine, and also in quickly reducing an enlarged spleen.

A dose of Epsom salts often brings on an attack of fever in a person, who imagines he has long been cured of the disease, and is thus often an aid to the diagnosis of chronic malaria.

As regards prophylaxis, anti-mosquito measures have, during the last few years, been systematically carried out in several district headquarter towns of the Central Provinces. These comprised the employment from June to December, under the supervision of the civil surgeon, of a gang of specially trained men, in filling in borrow pits, drawing off or paraffining collections of water, clearing the channels of *nullas* and ditches, draining off the overflow water round wells, and in cutting down and eradicating rank vegetation within municipal limits.

In the Betul District during the past year, there has been a large deduction in the number of malaria cases treated at the main dispensary, but in the other districts the effect of these measures has been doubtful, so far as regards a diminution of the fever cases. The records of the local dispensaries show no decrease in the number of cases treated, and the mortality returns of the towns in question show no reduction in the number of deaths attributed to fever.

However, during the five years these operations have been in progress, there has been no great increase in malaria, and these measures, apart from their general sanitary utility, may have prevented the disease assuming epidemic proportions at times.

As the general application of these measures would be prohibitive in cost, their practical introduction should be limited to cases from which the best results might be anticipated. Such cases, in my opinion, are not those of municipalities and cantonments which, as is well known, are less malarious than rural circles, but those of "*paraos*," halting-camps, and large junctions on main lines of traffic. Such places form a perpetual source of malarial infection. Persons under the necessity of halting at them do so under conditions most favourable to the mosquito.

The spread of sleeping sickness in Africa is known to be brought about by the localised infection of camping-grounds and "*paraos*."

It is in such places that efforts should first be directed towards the destruction of the mosquito.

To give an illustration. At Pachmarhi, the admission rate of European troops for intermittent fever in 1907 was 654 per 1,000, while the rates at Saugor, Jubbulpore and Kamptee were 286, 161 and 149 respectively.

Natives also suffer severely from malaria in Pachmarhi, while European officers and ladies are comparatively free from the disease.

The reason for this is that the soldiers and nearly all the natives break their journey at the foot of the hill, at a place called Singanama, which is teeming with mosquitos and exceedingly malarious.

The inhabitants of Singanama, and the neighbouring forest villages, suffer to a large extent from chronic malaria and enlarged spleens; they live under conditions most favourable to the "factor of residual infection." The mosquito finds unlimited breeding grounds, and a constant supply of food, thus every opportunity exists for persons halting for a few hours after sunset in the "*paraos*" to acquire the infection. They get an attack of malarial fever within two or three weeks subsequently, and accuse the hill station of being malarious.

The carrying out of larvicidal operations at Pachmarhi would thus be of very little use, so long as the source of the malaria is left untouched. This is but a solitary instance of a condition of things prevailing throughout the province.

In the Chhattisgarh division, for example, on all the main roads, there are long series of "*paraos*" used as halting-places for cart and other traffic, bringing in forest and other produce to the railways. Most of these "*paraos*," which are on the banks of a *nulla* or tank, and adjacent to some village, are exceedingly malarious. The annual sanitary reports of the Government of India show that it is not the towns and cantonments that are so subject to malaria as the districts.

It is easy for Europeans to keep more or less free of the disease by personal prophylaxis, *e.g.*, mosquito nets and quinine.

The disease can also be kept down in jails and other large institutions, even in times of epidemic, by the regular issue of quinine, as is proved more particularly by the Punjab Jail Report for 1908. But in the districts the issue of quinine can only be partially successful; it has been tried for many years, but the sale of the packet shows no increase.

Without, however, relaxing our efforts to popularise quinine, material progress in diminishing the prevalence of the disease might be made by systematic larvicidal operations on "*paraos*," rest-camps, and other halting-places on main lines of traffic.

Natives are continually on the move, attending marriage ceremonies, fairs or courts, and performing pilgrimages, and the commonest explanation met with, as to the cause of an attack of fever, is that it was brought on by some journey or other.

In each district a list of the more unhealthy "*paraos*" could be maintained, and operations could be commenced upon each in turn, with a view to—

- (1) destroy mosquitoes and larvæ, and get rid of their breeding grounds,
- (2) render the wells mosquito-proof,
- (3) issue quinine free to the local inhabitants and to place it at all times within their reach free of cost.

These operations should result in lessening the infectivity of such places, not only for malaria, but to a certain extent for cholera also, and thus tend to bring about a reduction in the prevalence of malaria throughout the district.

The following discussion ensued :—

Major Rogers: I propose to give an account of the investigations which have been carried out in Bengal for some years past. Firstly, I will deal with the enquiry regarding the Bogra District in 1901 and the effect of the silting up of the river on health. The main feature brought out was the intimate relationship between the high ground water level and the high malaria rate. One village situated on high ground had a spleen rate of only 10 per cent. against an average rate of about 50 per cent., while another village on a high bank of a river and where the ground water level was low had only 6 per cent. of spleen. The higher part of the district, which was the most dry was the healthier part. In the next enquiry in the Dinajpur District in 1904, an effort was made to ascertain the real cause of the deaths returned under the head of fever which ran into over 90 per cent. of the total. The result, roughly, was that only one-third of these were really due to malaria, another third due to febrile conditions such as pneumonia and phthisis, and the remainder to a variety of causes including cholera and small-pox. Further, intimate relationship was again found between the high-water level and the high malarial rate, while the difference in the death-rates in the different parts of the district was due almost entirely to the greater prevalence of malaria in unhealthy areas, the other diseases being fairly uniformly distributed. The next report of the Drainage Committee of 1907 gives records of an enquiry by Captains Proctor and Stewart regarding the districts of Jessore, Nadia, and Murshidabad. The ground water level of this area was so high that at the end of the rains it was only 3 to 4 feet from the surface. They enquired into the causes of the deaths returned under "fever" and obtained very similar results to those in the Dinajpur enquiry;

36 per cent. of the fever deaths being due to malaria. They also found that villages on the banks of live rivers with a good current and on high land and dry soil had a spleen rate of 45 to 46 per cent., while those on silted up rivers had a rate of 62 to 64 per cent. This is also in accordance with the ground water level; it would be higher in the latter than in the former. Further, villages in which the ground water level was less than 6 feet down had a spleen rate of 75 per cent., and in those with a ground water level over 6 feet down the rate was 55 per cent. Another important point they ascertained was that villages surrounded by dense jungle had a spleen rate of 71·7, those with little or a moderate amount of jungle only 44·5. This may also be connected with the high ground water level favouring the growth of dense jungle. They also noticed that pools of water were found in the jungle which were protected by it from drying up. In one *thana* of the Nadia District they found sporadic *kala azar* so prevalent that 16 per cent. of the deaths were due to it; but in the other areas examined the rate was only 2·4 per cent., and so not sufficient to invalidate the value of the spleen test for malaria. The next report is that of Captain Forster, the principal point in which is that in the Murshidabad District, which he investigated, sporadic *kala azar* was very widespread; so much so that there was no direct relationship between the spleen rate and the endemic index for malaria. The presence of this sporadic *kala azar* greatly complicates the problem in lower Bengal. Another point which I wish to raise is the importance of the relationship of meteorological data to the prevalence of malaria. Thus in the Chhota Nagpur District of Bengal excessive rain is followed by excessive fever, while in the Eastern Bengal, districts north of the Ganges, the opposite is the case, the cause being that that area is under water during the rains, and if the rainy season is prolonged during the year, and the period at the end of the rains is short before the minimum temperature falls below 60° when the development in the mosquito ceases. If, on the other hand, the rains are short, there is a long dry period and intense malaria. A closer study of such data in different parts of India for a number of years should enable such epidemics as that in the Punjab last year to be foreseen and give time to take measures against them. With regard to the statistical data required for Captain Christophers's method, I think it is very important that the vital statistics of smaller areas in the *thana* should be recorded in the offices of the Sanitary Commissioners. This would enable this method to be utilized.

President: It has always been said in Bengal for the last 30 or 40 years that malaria there is mainly due to obstructed drainage silted up by these dead rivers and that the silting up of dead rivers was due to railways.

Major Rogers: My first investigation of the prevalence of malaria on the banks of the Hooghly was by taking the ground water levels on each side of the Eastern Bengal State Railway for a distance of 25 miles. The highest ground is the bank of the River Hooghly. If the railway was obstructing the drainage it is obvious that the water level would be higher on the river side. But there was no difference between the two sides at all. That is the only example I have been able to work out thoroughly and there was certainly no evidence whatever as regards obstruction by this railway.

President: Then your conclusion is that the railway had nothing to do with it?

Major Rogers: The railway had nothing to do with it. It was very much more unhealthy on the east of the railway than on the west, whereas if the railway obstructed drainage the west side would be the worst.

President: You also spoke about the change of levels.

Major Rogers went on to explain that three different conditions prevail in the 24-Parganas, the Sunderband area, which was practically flooded, was the most healthy part of the district; the northern end, where the land was raised by silting, was more healthy than the intermediate part; the intermediate part where the process of silting was going on, and where it was not above flood level, is flooded during the rains and there results a process of drying up. This is the most unhealthy part. He considered this very important as there were costly schemes of drainage under consideration. The result of such schemes might be the turning of a healthy locality into an unhealthy one. The matter required very careful consideration.

President: Are these being done under the Sanitary Drainage Act?

Major Rogers: Yes. He then proceeded to say that the drainage scheme in the south of Calcutta, which is now being carried out, is being very carefully watched, and he was very strongly of opinion that such sorts of drainage scheme

should not be carried any further until the result of the present one was known. He touched on the Subramania scheme which he thought might do more harm than good.

President: It comes to this then, that you consider that it is not certain that these large drainage schemes would do any good at all?

Major Rogers thought the contrary and expressed his opinion that they would possibly do more harm than good.

Major Donovan next referred to the question of the distribution of malaria in the Madras Presidency and illustrated his remarks by means of a map based on Colonel King's investigations carried out in 1902. He said that the figures could not be very accurate but would show the malarious districts in Madras. His information was based on cases admitted into the General Hospital and from the returns in the office of the Sanitary Commissioner for Madras. From the investigations made by the Royal Society's Malaria Commission it would appear that the most malarious portions were at the foot of the hills. There were a few other places where malaria was scattered and might be described as artificial and not indigenous malaria. There was also lying along the eastern slope of the Western Ghats a portion under the same conditions as in the Jeypore hill tracts, but in Malabar and South Canara the conditions as regards malaria were identical with those at the foot of the hills. He suggested that investigation should be made in certain tracts.

Colonel Dyson said that in the Bombay Presidency there were fairly definite areas, including Sind, which were recognised as malarial. The Sind tracts comprise territory which was rendered malarious by the overflow of the Indus River at certain times of the year. In northern Gujarat there were tracts of forest country presenting a different condition of affairs. In still other parts the rice-growing tracts of Gujarat are malarious, and still further south one of the most generally recognised malarial tracts in the Presidency (in Canara District) is a forest tract. Contrary to what the last speaker just mentioned, the usually recognised malarial districts are not actually at the foot of the Ghats but above the Ghats. So as regards the Bombay Presidency there were certain definite tracts—possibly half a dozen—over which investigations would no doubt bring about good results. Major James had prefaced his remarks by saying that such investigations should precede any further measures to be taken, but no doubt they would hear later on in these discussions that there were certain measures which might go together with these investigations in the regularly recognised malarious tracts, and there seemed no reason why anti-malarial measures should not go on while these preliminary investigations were being made.

The President then submitted for criticism a draft which he had prepared formulating the result of the day's discussion. Various verbal amendments were suggested which after discussion were either accepted or rejected and the draft finally passed.

THIRD DAY.

Thursday, October 14, 1909.

PRESENT:

Sir Harold Stuart, K.C.V.O., C.S.I., I.C.S., *President*.

Mr. L. M. Jacob, C.S.I., Secretary, Government of India, Public Works Department.

The Delegates.

The President: Gentlemen, yesterday the Conference discussed the question of the distribution of malaria; to-day the first subject put down for discussion is the epidemiology and endemiology of the disease—why, for instance, we have a death-rate from fever of only 7 or 8 per mille in Burma and Madras and of more than 20 per mille in the Frontier Province and the United Provinces, and why some provinces are visited from time to time by intensely severe epidemics, while in other provinces such epidemics occur very rarely, if ever. Captain Christophers has written an interesting paper dealing with the epidemiology of malaria in the Punjab, which I shall now call upon him to read.

The following paper was then read, the points dealt with being illustrated by means of a series of coloured maps and diagrams.

On Malaria in the Punjab by Captain S. R. Christophers, I.M.S.

SYNOPSIS OF CONTENTS.

- I.—The manifestations of malaria in the Punjab.
- II.—Factors involved in the epidemic malaria of the Punjab.
- III.—The mechanism of epidemics.
- IV.—The prophylaxis of epidemic malaria.

I.—*The Manifestations of Malaria in the Punjab.*

The manifestations of malaria in the Punjab present some special features contrasting very strongly in some respects with those exhibited by the disease in moister and more tropical countries.

Though the Punjab in the summer months is one of the hottest regions in India it enjoys during the winter months a quite temperate climate. And as during these cold months and the very hot weather following them it also receives but little rain, it is not until June, when the monsoon sets in, that the conditions become favourable to the breeding of anopheles. Whether or not from this cause malaria remains in abeyance in the Punjab until the autumn months, when in greater or less degree it becomes prevalent. From time to time this autumn prevalence becomes exaggerated and the year is recorded as a bad fever year. But in 1908 this autumn malaria was so severe and was accompanied by so terrible a mortality that it roused general apprehension. As a result it has been my privilege to investigate the conditions associated with this malaria of the Punjab. My researches show an epidemiological picture so peculiar and interesting that I make no apology for bringing my observations before this Conference.

Before going into the general question of malaria in the Punjab some mention is required of the 1908 epidemic.

This epidemic made its appearance about the end of September and involved almost the whole of the Punjab. In parts most severely affected the epidemic is stated to have prostrated the entire population. In Amritsar, for example, for many weeks the ordinary business of the city was interrupted, labour could not be obtained, transport was disorganised, and even food vendors ceased to carry on their trade.

The effects of the epidemic can best be gauged by a study of the admission rates for fevers in the dispensaries and from the mortality returns.

The extreme suddenness of the outbreak is shown in all records whether of sickness or death as will be apparent from the charts* which I now show illustrating the admissions for fevers and the death-rates in several towns during 1908. A remarkable feature is the almost simultaneous onset of the epidemic throughout the Punjab. With the exception of the extreme south-east, where the characteristic rise from mortality took place about a fortnight earlier than in the northern part of the Punjab, places even hundreds of miles apart were affected simultaneously.

Another peculiar feature was that the increase in admissions to dispensaries for fever only very slightly preceded the increase in general mortality showing that deaths were not the result of protracted sickness but apparently of the intensity of the infection. This is borne out by accounts of Civil Surgeons and others who describe in Amritsar and elsewhere a great prevalence of pernicious cases, especially forms associated with fatal dysentery.

Still another peculiarity is that the mortality curve for almost any severely affected town or area shows the same features, namely, a sharp rise in the beginning of October, a high level maintained throughout October and November, and rates falling rapidly in December and January to normal. The dispensary returns show the same sharp rise but a more prolonged effect, as will be evident from the curve showing admissions to Bhera dispensary. In this latter case the slow return to normal seems in most cases to have been mainly due to persons coming for treatment of enlargement of the spleen, rather than for fever.

During the two months of October and November the number of deaths recorded in the Punjab as due to fever was 307,316 as against less than 70,000 in both 1904 and 1905 and less than 100,000 in 1907.

Studied in more detail the ravages of the epidemic in those areas where it

* Not printed.

was most intense are even more apparent. In Amritsar the mortality for many weeks was at the rate of over 200 per mille. In Palwal mortality rose to 420 per mille and in Bhera to 493 per mille. Curiously enough in Delhi, a notoriously malarious town, the death-rate rose to only 149 per mille. But a closer examination of the statistics shows that parts of this town were much more seriously affected than one would judge to be the case from the statistics for the whole city; in Ward I, for example, the mortality rose to over 300 per mille.

The death returns of Amritsar show that the densely crowded outer portions of the city were mainly affected. Again, in these the mortality was much higher than the figures for the whole city would indicate. In Division IX, for example, with a population of 17,206 the death-rate rose to 534 per mille and for six weeks was over 400 per mille.

In the district returns, with the exception of those relating to the Gurgaon district which show among a population of 687,199 a death-rate of 267 per mille, the mortality rates are not so high as those given for the towns. This might be taken as showing that the mortality was greater in towns than in rural areas, but a study of returns from individual *thanas* and villages modifies this conclusion, both *thanas* and villages frequently showing mortality rates during October and November of 300, 400 or even 500 per mille.

A peculiar feature of the mortality was the heavy toll that it levied upon infants. The curve compiled from deaths in Amritsar shows very clearly the age distribution of the mortality.

Only one other disease, plague, causes such frightful mortality, and one often hears doubts expressed as to whether some other disease than malaria was not concerned in this epidemic of so-called fever in 1908.

But there cannot be any doubt as to the true nature of the epidemic. It exhibited the well known incidence of malaria in the Punjab, corresponding exactly with the seasonal incidence of this disease and of the prevalence of malarial parasites as shown by the observations of Dr. Stephens, Major James, and myself among the natives of Mian Mir and by the prevalence of parasites in European soldiers in cantonments. It attacked especially the infants, a well known peculiarity of malaria; and it was accompanied everywhere by an increase in dispensary admissions for what was clinically malaria; it was also followed everywhere by a notable increase in the numbers of people suffering from splenic enlargement.

Examination shortly after the epidemic of areas especially affected showed in every instance a remarkable condition of almost universal infection with malaria. In Palwal and the affected areas of Amritsar almost every child had splenic enlargement and malarial parasites in the blood. In Bhera and in the villages of the Bhera *thana* the same condition prevailed.

In Amritsar the distribution of enlarged spleens and of parasites tallied exactly with that of the mortality as will be seen from the sketch maps which I now show. In those areas where the epidemic was absent or exhibited itself mildly, as Katra Chauk Pasian, few or none of the children had enlarged spleens; where it was transient, as in parts of Katra Allowalian, one found children with spleens but slightly enlarged or just palpable; where the epidemic was especially severe, as in Katras Khazana and Ramgurian, not only had almost every child parasites in the blood, but the spleens were notably large and more tumid than usual; from 25 to 50 per cent. of the adults were also affected.

In the rural areas the same relation of mortality to malarial conditions held good; wherever a village had been severely visited by mortality the inhabitants, and especially the children, showed profoundly the effects of malaria. Outside the epidemic area things were very different and the number of children with enlarged spleens after did not exceed 25 per cent. The tumid spleen so characteristic of places severely visited by the epidemic was also much less frequently seen outside the affected areas.

The Distribution of the Epidemic.

As regards distribution the epidemic affected to some extent almost the whole Punjab. In the towns a rise in deaths in the months of October and November was almost universal. Almost all the districts show some increase in the death-rates during the autumn.

If we colour a map of the Punjab according to these district figures we get a result as shown.

A more detailed and much more instructive picture of the distribution of the mortality is that obtained by the method of using *thana* figures which I have described in another paper read at this Conference.

Mapping out the 1908 epidemic in this way we get the results illustrated on this map.

There are many points worthy of notice. It is clear that the malaria of 1908 occurred in the form of two epidemics, one in the north involving Gujrat, Gujranwala and Shahpur, and one in the south-east involving Gurgaon, Delhi, and parts of Rohtak. Other epidemic areas are shown, notably one over Ludhiana and part of Jullundur; but in comparison with the two large areas noted these are small in area and low in intensity. This distribution tells us much concerning the malaria of the Punjab we did not previously know.

In the first place it is important that such definite epidemic areas can be mapped out at all. Had the malaria of 1908 depended merely upon local causes, the number of pools about a village and so on, we should have expected to obtain a map covered with confused figures indicating haphazard variations as the intensity of the disease rose or fell from *thana* to *thana*. There would be no reason why several affected *thanans* should form as it were a nucleus to epidemic areas or that the intensity of the disease should show a more or less regular decline as we pass outwards from these foci.

The map shows us conclusively that there is some general determining factor over and above local conditions which acts over these epidemic areas and with increasing intensity as we approach their focus.

It shows also many other interesting facts. A very notable feature, especially of the northern epidemic, is the occurrence of certain tongues of epidemic which tend to follow in the line of different riverain tracts, one along the Jhelum, one over the Chenab, another over the Ravi, and some isolated spots over the Sutlej riverain.

But what I wish most to emphasize at present is the peculiar character of the areas of special intensity which are shown in the centres of the epidemic. In the southern epidemic, for instance, we see an area extending over much of the Gurgaon District in which every *thana* had a death-rate of over seven times the normal. In the centre of this tract are *thanans* showing death-rates during the epidemic from ten to as much as seventeen times the normal. In the *thana* of Nuh, for example, where normally there are about 125 deaths in the month, there occurred in October, 1908, no less than 1,404 deaths. In the *thana* of Hodal, which normally has about 100 deaths, there occurred in October 1,083; in the *thana* of Ferozepore with a normal of 130 deaths per month there occurred 2,346 deaths.

In the northern epidemic there is the *thana* of Gujrat with ten times its normal death-rate and villages showing in some cases a mortality as much as 30 and even 50 times the normal.

In the special focus shown at Bhera there are scarcely any villages showing a death-rate below 200 per mille, whilst the majority range between 200 and 500, and one shows the extraordinary figure of 641 per mille.

If it were not for Bhera town itself, which shows an equally high mortality rate, we should hesitate to credit these extraordinary values. Yet if there be errors of registration they must err on the side of under-estimating rather than over-estimating the mortality.

If we refer to the figures for the small towns we shall see that it is those towns situated in areas of special intensity which have suffered so severely in the epidemic of 1908. Palwal and Bhera we have referred to, but there are others not mentioned in the published returns equally profoundly affected, as for instance, Hodal, which in October had a mortality rate of 554 per mille.

One feature then of the epidemics is the occurrence at certain central portions of the epidemic areas, of foci so profoundly affected that we can scarcely credit the figures we are dealing with. It is the effect of malaria of this kind which has caused such alarm and apprehension, for though it is recognised that fever was bad generally throughout the Punjab, it is the conditions in Amritsar, Gujrat, Palwal, and Bhera that one hears cited as showing how terribly the people suffered in this epidemic, and this statement is further borne out if we examine the distribution of deaths, for taking the comparatively small area in which *thanans* show over seven times the non-epidemic death-rate we shall find that instead of the deaths in October numbering 6,841, which is an average non-epidemic rate for these *thanans*, they

number 76,256, leaving only about 100,000 deaths for the whole of the rest of the Punjab. Tracts affected in this way by malaria I have for convenience termed "fulminant areas."

We might describe the year 1908 by saying that there were two main epidemic areas, one in the north with fulminant areas over Gujrat, Amritsar, and Bhera, respectively, and one in the south with a fulminant area over Gurgaon. The relation of these fulminant areas to the general malaria of the Punjab may be realised from the diagram which I now show.

If we judge from remarks about the 1908 epidemic we may be led to think that in this year some special new conditions were introduced which have accounted for the virulency of the disease. Let us see how far such an idea is tenable.

Previous Epidemics.

Wishing to map out malaria for past years as I have done for 1908, I was much gratified to find that the necessary information was available in the Sanitary Commissioner's office, and from the records very kindly placed at my disposal by the Sanitary Commissioner of the Punjab, I have been able to map out malaria in years in which fevers were especially prevalent as far back as the seventies.

If for reasons I have given in a previous paper, we compare the total deaths in the Punjab during October and November for different years we shall be able to pick out years in which the autumn deaths showed a great increase (*vide* diagram). If we map out malaria in the years thus indicated we shall find that each year of heavy autumn mortality has been one in which the Punjab has been visited by an epidemic and that these epidemics like those of 1908 are localised to certain tracts, have fulminant areas, and exhibit the other characters which I have pointed out in the epidemics of last year.

The maps so prepared I am exhibiting to-day; they are, I venture to say, of extreme interest. Unfortunately in the space at my disposal it is necessary to confine myself to a very brief notice of the features they exhibit.

The years specially noticeable for a high autumn death-rate are 1908, 1900, 1894, 1892, 1890, 1884, 1879, 1878, 1876, and 1869.

In 1900 there was a large epidemic over Ludhiana, Umballa, and Karnal. In the heart of this epidemic is a fulminant area as great in extent as any such area in 1908. To the north over Gurdaspur and Sialkot is another smaller epidemic area with a fulminant area over the valley of the Ravi. In the south of the Lahore District we see also a small fulminant area over the Sutlej riverain. The deaths in the autumn of this year numbered 254,580, as against 307,316 in 1908. Therefore even so late as 1900 we have a condition very similar to and a mortality not very far short of that in 1908.

In 1894 there is a single epidemic area over Gurdaspur, Amritsar, Jullunder, and part of Sialkot and Hoshiarpur, with a small fulminant spot to the north of the Amritsar District and one near Jullunder. The lighter green shows areas bearing an epidemic figure over 2 and 3 respectively. The epidemic shows a "contour" effect that is very remarkable. The deaths in this year for October and November numbered 132,767.

In 1892 there is again a single epidemic area but of enormous size. This year in fact is one remembered as the great fever year. But in spite of the enormous fulminant area extending over several whole districts, there was in the southern Punjab no trace of an epidemic, the death-rates indeed for most of the *thanas* in Gurgaon, Delhi, Karnal, and Rohtak were not raised above their non-epidemic rates. In this epidemic there is a small isolated fulminant area over Bhera as in 1908. The epidemic distribution also exhibits very strikingly the long tongues of raised mortality we have previously referred to as characteristic of the 1908 epidemic. The deaths in this year numbered 283,223 or only slightly less than the number in 1908.

In 1890 we have an extraordinarily compact epidemic, again, with a large fulminant area mainly over Gujrat, Sialkot and Gujranwala, characterised by terrible mortality rates, Wazirabad having an epidemic figure of 28, Sialkot of 26, and Gujrat of 24. In this year the deaths numbered 246,487 in spite of the fact that the whole southern portion of the Eastern Punjab was unaffected.

In 1884 we have an epidemic area somewhat in the same position as that of 1900, namely, over Ludhiana and Umballa with a fulminant area also characterised

by very high figures. Machiwawa showing 30 times the normal death-rate, while several *thanas* are 18 and 19 times the normal. There are also three curious small isolated fulminant areas, one in the low-lying area of Tanda Umar, one near Delhi, and one in the Sutlej riverain near Ferozepore. A peculiar tongue of the epidemic is seen lying along the Jumna riverain in the Karnal District.

In 1879, a notorious fever year, we see how localised was the epidemic and the enormous extent of the fulminant area. In this year the autumn deaths were 142,006 in spite of the fact that registration of deaths at this time was evidently much less complete than at present. The whole of the northern area was practically untouched by the disease.

In 1878 we have a very peculiar epidemic affecting Jullunder, Hoshiarpur and Ferozepore. The main fulminant area lay over the Sutlej riverain. Some tongue-like areas of epidemic are seen in the Jhelum, Chenab, and Ravi riverains.

In 1876 there was a peculiar epidemic lying close up to the hills involving Hoshiarpur and Gurdaspur.

Of the 1869 epidemic I have not been able to get any detailed information.

Thus each year of heavy fever mortality is one of epidemic conditions affecting severely as a rule only a comparatively small portion of the Punjab. Judged by their distribution three types of epidemics can be distinguished—

- (1) Epidemics occurring in the north of the submontane and central tract.
- (2) Those about Umballa and Ludhiana.
- (3) Those in the south-east of the Punjab.

Out of the nine epidemics five, namely, those of 1908, 1894, 1892, 1890, and 1876, are northern in type. Three, 1900, 1884, and 1878, are central, and two, those of 1908 and 1879, eastern in type.

Even in years not so tremendously characterised by mortality we shall find that the autumn fevers exhibit the same tendency to localisation, but being smaller in degree and insignificant in area, such epidemics do not influence the general statistics as do the great ones we have just described.

For want of time I have attempted to trace out a few recent years only; 1906 is an example of a year with small epidemics of the central type; 1903 also shows incipient epidemic areas; 1904 was practically free from any epidemic, and it is noticeable that the deaths for October and November are not above the normal non-epidemic rate of about 30,000 per mensem.

The conditions in the year 1908 were therefore in no way new to the Punjab. Even as regards gross mortality it was but slightly more severe than the epidemic of 1892, and as regards its fulminant areas they were neither so extensive nor so severe as those of some previous years.

We cannot then plead that the conditions of 1908 were so very exceptional. We may expect something approaching them any year. We can be certain that in the future many such epidemics will visit the Punjab. Let us see so far as we can the general effect of this recurring fever mortality.

The total death-rate in the whole Punjab from non-epidemic fevers is in round figures about 30,000 per month. In a year we should get 360,000 deaths from non-epidemic fever. In this category are included such diseases as tuberculosis and many others. It practically represents the residue of deaths from all causes after abstracting a certain number of deaths for plague, small-pox, dysentery, &c.

In 1908 an equal number of deaths occurred in two months from epidemic malaria alone. In the Gurgaon District, which normally loses from non-epidemic disease about 17,508 persons in the year, there occurred in the month of October, 1908, no less than 15,740 deaths or nearly as many people as would have died in a whole year from non-epidemic disease. Sialkot, which normally loses about 3,000 a month from non-epidemic disease, lost in October, 1890, 33,609 persons, and in October, 1892, 20,972. Gurdaspur, which normally loses about 2,000 a month, lost in October, 1890, 11,976, in October, 1892, 18,921, and in October, 1894, 10,551 persons. Umballa, which normally loses about 1,500 a month, lost in October, 1890, 17,025 persons.

If such conditions are repeated several times in a decade it is not wonderful that we should see the effects when the decennial census is made.

In these epidemics we see in fact the instrument by which malaria attacks the Punjab. Endemic malaria certainly exists, but it is the mortality from the epidemic disease which gives to malaria in the Punjab such prominence.

II.—*Factors involved in the Epidemic Malaria of the Punjab.*

That in the Punjab a bad malarial year follows upon an excessive monsoon rainfall is a common belief; on the other hand attempts to show a close relation between rainfall and malaria have not been very successful.

In order definitely to decide this important point I have studied in some detail the question of the distribution of epidemic malaria in relation to rainfall in the Punjab.

Rainfall.

In 1908 the rainfall in the early months of the year was below the normal and its distribution shows no relation to the epidemic areas. Unusually heavy rain in the early months is therefore not necessary for epidemic conditions.

Again, at Palwal the heaviest rain fell chiefly in the early part of the monsoon; at Bhera the heavy and unusual rain which flooded the area fell very late in September. Many other instances of a like kind could be given. The exact distribution of the rain in the monsoon does not then seem of great importance.

We may commence, therefore, by a consideration of the relation between the total monsoon rain and epidemic malaria. If we put side by side deaths from fever in October and November and the average rainfall for the Punjab, we see roughly that in many cases the bad malarial years were associated with a heavy monsoon, but we have several instances where not only has heavy rain occurred without a heavy mortality, but there have been fever years with a by no means excessive rainfall. This will be clear from this chart which has been adopted from the census of 1891. This method is, however, at the best a clumsy one and liable to lead one to false conclusions. A much more delicate method can be employed. There are in the Punjab some 30 recording stations for rainfall and records for these dating back to 1884 have been kindly placed at my disposal by the Director-General of Agriculture. From these it is possible to plot out upon a map the different amount of rain falling at these stations in any year. If we do this we get instead of an unintelligible mass of figures, a clear picture of the rainfall conditions. The method has the advantage of enormously simplifying comparison of rainfall and malaria.

The epidemic maps for different years I have already exhibited. With these we may compare those showing the distribution of rainfall. We see at once that the general position of the epidemic areas is determined by the rainfall. When heavy rainfall is widespread malaria tends to follow its distribution. Not only so but the fulminant areas are always associated with the areas of greatest precipitation.

When rainfall is excessive we get large and intense epidemic areas, in years of small rainfall epidemic areas, if they exist, are smaller and less intense, as for example, in 1907. Nevertheless we can clearly see that there are other factors determining the exact distribution and intensity of epidemics.

The boundaries of the areas are in the first place rarely exactly marked out by the distribution of the rainfall. The epidemic tongues, for example, are features apparently apart from the distribution of rain. The extent of the epidemic also bears no definite and constant relation to the amount of rain. For example, in 1894 very heavy and widespread rain fell, but the epidemic was localised to those areas which received very excessive rain indeed and then it was not very intense. In 1906 again there was heavy rain with little fever. In 1901, with a much less rainfall, fever was more general than in 1894, though there was no large epidemic. In 1892 the rainfall was not so excessive as would be imagined from the extent of epidemic malaria.

Though then rainfall determines the area affected, and to a large extent the general characters and intensity of the epidemic, its effects are modified by some other factors.

Physical Features.

In the 1908 epidemic the specially affected areas were in the neighbourhood of Palwal, Hodal, Ferozepore, in Amritsar City, Gujrat, and Bhera.

The Gurgaon area is part of the riverain of the Jumna which here forms a broad plain with a slight slope towards the foot of the hills which lie behind Nuh. As a result of this conformation and the impervious character of the silt, of which the plain is formed, heavy rain results in large tracts being more or less inundated.

Palwal and the other affected towns were in fact as a result of heavy rains in 1908 surrounded by water which lay for several months before it eventually dried up; and in February some of the villages of this district were still almost surrounded by water. The subsoil water at the time of my visit was not infrequently found almost at the surface, and throughout the affected area it was rarely at a depth of more than five or six feet.

Amritsar lies in a shallow depressed area in one of the lines of drainage of the Bari Doab. It is normally surrounded by many sheets of water and the conditions are such that ordinary rain results in innumerable pools. Nevertheless it has only three times been visited by severe fulminant malaria, namely, in 1876 when deaths in October numbered 2,430, in 1881 when deaths in October numbered 5,582, and in 1908 when deaths in October numbered about 4,000. The special feature of 1908 and other fulminant years was "flooding."

Bhera lies in the Jhelum riverain where this forms a broad plain only slightly above river level. The whole area as a result of heavy rain was more or less flooded. Bhera itself was so surrounded by water that it is stated that one could have gone round the town in a boat. At the time of my visit the floods had disappeared. There was a number of pools with anopheles larvæ, but the city as regards mortality had more or less resumed its normal state.

Gujrat *thana* lies where several torrents from the hills debouch upon the Jhelum. The whole *thana* is intersected by the channels of these streams which are constantly bursting through their old beds and taking to new ones. Heavy rain at their sources greatly swells the streams and they then frequently flood large tracts of country. Many villages on old beds are also liable at such times to be flooded.

In this *thana* an analysis of village statistics gave the distribution of malarial mortality shown in the map. Visiting sample villages the results given were borne out by the conditions found. In village Nairowali, for example, which had an epidemic figure of 2, only eleven per cent. of the children had enlarged spleens. The villages Gurali, Gurala, Jandiala, and others all showed the usual condition found within the epidemic area, namely, a spleen rate for all practical purposes of 100 per cent. among the children and from 25—50 per cent. among the adults. Nairowali was situated so that flood waters did not lodge but flowed away in three directions, they affected villages so that floods had collected and surrounded the villages with standing water.

It is interesting to note that anopheles were quite abundant at Nairowali so that the escape of this village is not due to any want of ordinary breeding facilities.

The tract of healthy villages shown near Nairowali bordered on the somewhat higher ground of Dingah *thana* which showed the effect of the epidemic to a much less extent than that on Gujrat.

Two patches of intense mortality at (1) and (2) were areas flooded by the overflowing of the Bhimber and the Shah Jehangir *nullahs*, respectively. The area near the Bhimber when visited was so flooded that the villages were approached with difficulty. The village Nand was on low land by the river and was flooded in 1908. Nurpur was in the deserted bed of the Shah Jehangir *nullah* and is inundated by this river when in heavy flood. The villages in the south-west corner could not be got at in the time at my disposal owing to floods which made the roads impassable.

The influence of physical features was made extremely plain in the Shahpur District. I investigated this district in order to ascertain the nature of the epidemic tongues I have previously referred to. The map gives on a larger scale the most northerly of the tongues indicated in the map of the 1908 epidemic. The fact that the epidemic tongue had been determined by the Jhelum riverain is very apparent. But it is very interesting to observe that passing down the riverain the epidemic conditions became less and less until at Sahiwal the epidemic figure was only 2.

An analysis of village mortality in this *thana*, which forms as you see from the maps a transition between highly affected and less affected areas, shows large tracts especially to the south towards Sahiwal in which the villages had very low epidemic figures. In other parts the villages exhibit high figures. One of these lies to the north bordering upon the affected Jaurian *thana*. Another isolated area lies at a considerable distance from the river to the east. The differences in physical features between the healthy tracts and the affected areas were obvious. Whilst the

healthy ones were drier with subsoil water at a depth of 12 feet or more, the affected ones had been subjected to floods and showed subsoil water as in fulminant areas within a few feet from the surface. At village Wegowal, for example, the subsoil water was at a depth of only four feet and the whole area had been flooded by an inundation canal.

A very striking example of the effect of flooding was the village of Kandan which though it was situated amongst villages having low epidemic figures was conspicuous as possessing an epidemic figure of 30. This village was found to be situated unlike the others on low ground near the river, and though not subject to heavy rain in 1908, it was flooded by the Jhelum itself.

It is worth mentioning also that of the *thanas* to the extreme west of the Punjab, which had been severely affected, all are situated close to the large rivers, and I suspect will be found to have been subjected to floods in 1908.

In the space at my disposal I cannot further increase examples, but those I have given are sufficient to show the association between fulminant areas and flooding.

If we turn to other parts of the 1908 epidemic we can see the same effect of physical features produced in other riverain tracts. But as we pass away from the epidemic area, riverains cease to be affected. In 1908, for instance, we see several riverains exempt from severe epidemic conditions which in past epidemics have been picked out from time to time as fulminant areas.

One powerful determining factor of the intensity of epidemic conditions is then the presence of tracts exceptionally situated and characterised by being low lying and having a high level subsoil water. Yet it is clear such conditions alone without heavy rainfall do not lead to epidemic malaria. But with a given amount of rainfall they are more readily converted than more favourably situated tracts into fulminant areas.

But a glance at the epidemic map shows us that such physical conditions are not absolutely necessary for the production of a fulminant area. Provided sufficient rain falls, almost any tract seems to be capable of being reduced to the necessary condition. A good example is Jullunder. Jullunder is comparatively rarely visited by large epidemics and appears to be able to stand a good deal of rain without becoming fulminant; but in 1894, when over 40 inches of rain fell, it was nevertheless involved.

It would be possible then to map out the Punjab into areas of various degrees of danger as follows:—

- (1) Highly dangerous areas as, for example, the Jhelum riverain at Bhera, the Sutlej riverain near Ferozepore, Amritsar, Bangah Rahon, and the *thanas* lying along the foot of the Siwaliks in Hoshiarpur, and so on.
- (2) Areas affected by moderately heavy rain, such as much of Sialkot, Gujranwala, Montgomery, Rohtak, and Karnal.
- (3) Areas requiring exceptional rainfall to affect them as the Bar in Shahpur, the central portions of the Lahore District, Lyallpur and others.

Some of these areas are perhaps scarcely ever likely to be profoundly affected as they lie out of the range of the monsoon rains. Others we cannot say when some special distribution of rain or of flooding rivers may not affect them, and others again we know to be frequently affected.

Before such a plan of differentiation could be carried out each *thana* would have to be visited and its salient features as regards its behaviour to malaria carefully appraised. We should then, with the knowledge of the rainfall, be able to predict not only general area and intensity, but to some extent the special distribution of the resulting epidemic conditions.

There are however some other matters which it is necessary to take into consideration.

Irrigation.

The very moderate effect of irrigation in these epidemics is very clearly shown. Areas irrigated by "inundation" canals are naturally physically suitable for epidemic conditions; but the great canals of the Punjab for the most part irrigate high lands unsuitable for epidemic malaria, and, in spite of irrigation and a certain amount of endemic malaria, stand out in relief as areas of low epidemic mortality.

We see here then Mian Mir in a truer bearing. However much the canals are infected with anopheles the true origin of severe epidemics would seem to be, as

in the rest of the Punjab, flooding. Like the rest of the Punjab it is liable in some years to be affected; in other years it escapes. In 1904 and 1905, for example, the statistics show a small amount of sickness; but the same is shown everywhere; it is even apparent in the figures for the rural areas of the whole Punjab.

The effects of heavy rain are not the exception, but the one thing which mainly determines the year's healthiness or the reverse all over the Punjab.

The most serious effect produced by irrigation is an indirect one due to the general raising of the subsoil water and an increased liability to water-logging.

The Influence of Squalor and Poverty.

If we examine in detail any town affected by the epidemic, we shall find that the heaviest mortality has been in those classes which are the poorest and living in the greatest squalor. This is very clearly shown in Amritsar, the death-rates in 1908 among Mahomedans, who form the lowest classes, being in October 390 per mille, as against 203 among Hindus, and in November 329, as against 181 among Hindus.

Again, Palwal as compared with the villages around shows a greater mortality rate. The malarial conditions in both are identical or slightly more adverse in the villages; but whilst Palwal has a large population of dependent classes living in great squalor and poverty, the villages have a population consisting for the most part of well-to-do cultivators with a small proportion only of dependants.

Bhera is a town at first sight prosperous and well-to-do, but a closer survey makes one suspect this appearance. There are in the town *mohullas* swarming with the lowest classes living in a very overcrowded and squalid condition.

Again, if we ask why Amritsar shows such a peculiar liability to be visited by terrible fever epidemics, we can point not only to its physical conditions, but to its squalid populations, its industrial character, and so on. In fact, in 1881 we see a malarial outbreak the almost direct result of Kashmiri destitution at a time of industrial depression. Even in 1908 we find the chief epidemic centres just in those parts of the city largely populated by Kashmiris engaged in various fabric industries.

One may say that the amount of mortality in any town or village will be determined very largely by the relative proportion of well-to-do to partially poverty stricken dependant classes.

Scarcity.

The conditions we have just mentioned are local and probably do not greatly vary in any given locality. Another factor to be considered is the possible effect of general prosperity or the reverse from year to year. It is well known that for several years prices in the Punjab have been very high. The epidemic of 1908 is an instance of an epidemic associated with high prices. Looking back we see other examples of epidemics associated with or following periods of scarcity, as for example, the great epidemic of 1879 which followed severe scarcity in the southern districts.

Comparing curves showing the price of foodstuffs and the prevalence of epidemic conditions in different years, we see that out of the nine great epidemic years described, seven, namely, those of 1878, 1879, 1890, 1892, 1897, 1900, and 1908, were during times of high prices. A great epidemic in 1869 and one in 1870 also occurred at a period of specially high prices.

The epidemics of 1884 and 1894 however were associated with low prices; 1876 was another epidemic year at a time when recorded prices were low.

What the conditions associated with the 1886 epidemic were, I have not yet been able to ascertain either as regards rainfall or scarcity; but in 1894 it is very noticeable that though the rainfall was very heavy and widespread the epidemic was one of the least intense and one of the most circumscribed of any we have described. In this year, Hissar, Rohtak, and Ferozepore received between 20 and 30 inches of monsoon rain, a quite phenomenal amount, but there was no epidemic in these areas, the death-rates not even showing any marked increase over the normal.

In 1884 not only was the precipitation in the affected area very heavy, Umballa receiving 44 inches and Jagadhari 71 inches of monsoon rain, but this year is recorded as one in which the very districts affected underwent great hardship owing to the failure of crops.

These facts certainly support the view that scarcity is a factor determining to a large degree the situation, extent, and intensity of epidemics. But to ascertain the effect of this influence we require more information than the current prices of foodstuffs; for whilst prices give us some idea of the degree of general scarcity, they fail to point out to us areas especially affected by failure of crops and other adverse conditions, the reason being that there is a very remarkable averaging process in regard to ruling prices so that however severely one area is affected by shortage of crops the prices after a brief discrepancy tend to level up if the other areas are unaffected. High prices may even increase the prosperity of a tract in which crops have been successful.

Without going further into this question, which would require more space than I can devote to it in this paper, we may say that periods characterised by high prices are likely to be followed at the first heavy monsoon by an epidemic, and that particular areas subject to adversity are likely to be picked out by epidemics if the other factors are favourable to this result. It is significant in this respect that whilst there are three types of epidemics, northern, central, and southern, and that these rarely occur together in the same year, there are also three main types of agricultural areas, namely, a wheat area in the north dependent mainly on the spring crop, a maize area in the central districts, and a grain and millet area in the south, both dependent mainly on the autumn crop.

III.—*Mechanism of Epidemics.*

We are now in a position to discuss the actual mechanism by which epidemic conditions are brought about. We may briefly summarise our conclusions as regards the factors concerned in epidemics by saying that three factors at least are concerned—

- (1) A general modifying influence of the effect of scarcity, high prices, and so on.
- (2) Physical features of such a kind as determines water-logging and the collection of large sheets of water on the surface.
- (3) Rainfall.

Curiously enough physical conditions associated with subsoil water at a high level, and with much standing water at all times of the year, do not bring about the epidemic disease unless rain falls in considerable amount; and though such places may exhibit a good deal of endemic malaria this does not apparently prevent epidemic malaria when it appears raising the death-rate to many times the normal. Again, though in an ordinary year sufficient rain falls to make many pools, and anopheles seem quite plentiful, the terrible fulminant manifestations of malaria are not exhibited.

What is it that enables a certain amount of extra rain so marvellously to alter the normal conditions, and in what way is it that water-logging acts in assisting epidemic conditions?

Before answering these questions we may with advantage ask; why is malarial infection in children at one time associated with but little mortality, and at another with such fatal effects?

That we are not dealing in these epidemics with any new form of parasite is clear from the results of blood examination in Amritsar and elsewhere in which only the well recognised varieties were found. It is also perhaps scarcely necessary to say that the mere name malignant given to one parasite, and benign to another does not signify that one is fatal and the other innocuous.

What then is intense malaria?

Intense Malaria.

The answer to this question is I believe to be got at on the lines of some experiments I have undertaken in order to find out what was the effect on being bitten by a few or by a great number of infected mosquitoes. This point was raised by Colonel Leslie, I.M.S., and it seemed to me to be an important matter to determine. To carry out satisfactorily such an investigation on the human subject would be extremely difficult, but in proteosoma of birds we have a closely related disease very suitable for experiment. I ascertained in my earlier experiments that by using a large number of mosquitoes one could increase the severity of the infection and shorten the incubation period. Further experiments showed me that there were other factors

than the number of bites. One of these is very important and must be briefly touched upon.

If a mosquito (*Culex*) be fed on a sparrow whose blood contains only a few gametes of proteosoma, the mid-gut of the mosquito will on dissection naturally show only a few zygotes, and if a batch of mosquitoes so fed be examined when the zygotes have matured and the sporozoites have reached the salivary glands, we shall find only a very few of the salivary cells packed with sporozoites. It is evident that such a mosquito feeding on a bird will inject at the most a comparatively small number of sporozoites.

If we now feed some mosquitoes on a bird whose blood contains very numerous gametes, we shall find the mid-gut studded with hundreds of zygotes and dissecting such mosquitoes when the sporozoites have reached the glands, we shall find that these are packed and swollen to many times their normal size with innumerable multitudes of sporozoites. Such a mosquito must inject a dose perhaps a hundred times greater than one of the slightly infected mosquitoes we have referred to.

Using scantily infected mosquitoes even in large numbers it was difficult to get a severe infection; single heavily infected mosquitoes on the other hand often gave quite severe infections. But by using a number of heavily infected mosquitoes, not only was the incubation period reduced from nine days to as little as five days, but the resulting infections were much more severe and death in every case occurred.

When a bird already having parasites in its blood was bitten by heavily infected mosquitoes it still developed a new infection over and above the old.

The amount of infection carried by mosquitoes then depends on the number of zygotes which develop in the gut, and the number of these in turn depends upon the number of gametes in the blood of the sparrow by which the mosquito became infected.

It is easy therefore to see that in malaria everything may depend upon the existence of heavy gamete carriers; and if these are present, upon the number of anopheles. Otherwise the relation of number of anopheles to the amount of fever will not hold good.

Malarial infections must then be studied quantitatively. An endemic index of 100 per cent. may be represented by a community containing only a few parasites in their blood and living in a condition of comparative health. In another case the same index may refer to a community heavily infected and prostrated by fever.

In the Punjab one frequently hears matters discussed as if the population was uninfected and remained so until the fever season came round when any individual was more or less liable to catch infection. It is nearer the truth to say that we have a population already infected and that what happens in the fever season is the "hastening up" of this infection and its kindling into a flame.

Bearing in mind these facts we may proceed to consider the effect of our three factors in bringing about an epidemic.

High Subsoil Water.

That a high subsoil water causes pools, that would otherwise be dry, to retain water is known to everyone; but there are some considerations in connection with subsoil water worth a brief mention.

When rain falls two forces are in action causing any collections of water unable to drain off to sink into the soil; these are gravity and capillarity. The relative value of these two forces depends upon the nature of the soil. In loose sandy soil gravity is an important force; in close impervious clay or silt this force acts much less effectively, and capillarity is mainly concerned in the disappearance of surface water. This is clear from experiments which I hope to publish in another place, but which I have not space to give in this paper.

When by saturation of a fine silty soil like that of the Punjab, the power of exercising capillarity is wholly or in part done away with, rain water sinks in with extreme slowness.

It is thus that subsoil water acts in what are known as water-logged soils. If the subsoil water is at a depth of only a few feet the soil, even to the very surface, has drawn up moisture and has thus lost partially or wholly its power to absorb by capillarity; it is thus rendered extremely impervious.

When the subsoil water is on the contrary at a considerable depth, any rain

falling on the soil finds it ready to exert its full absorptive power, both gravity and capillarity acting.

When more rain falls surface water is still acted upon by capillarity because the soil at a given depth is still absorbing water from the upper portions. But if sufficient rain falls in a sufficiently short space of time, there comes about a condition in which either the descending moisture meets with the saturated layer above the subsoil water and capillarity ceases to act, or owing to the depth of moist surface soil, capillarity cannot act with sufficient speed to affect the surface and again we come to water-logging, but in this case independently of subsoil water altogether.

Rainfall.

When water-logging has come about and rain falls the number of surface pools and the time they retain water is greatly increased. Still it is difficult to see why epidemic conditions cause a mortality so vastly in excess of the normal, for in every year a certain amount of rain falls and a moderate amount of rain should produce a proportionate effect. But the facts seem to show that rain must reach a certain amount before fulminant malaria can develop.

It is here I think our notions regarding malarious conditions require some expansion. We are apt as a result of the search for larvæ at all times of the year to look upon the various breeding places we find as the chief source of anopheles. In Amritsar, for instance, we may map out at any time quite a large number of breeding places, and if we do not trouble to think about the matter, we shall say perhaps that it is such a condition which gives us the disastrous results we have had in 1908. I venture to say that it cannot be so because otherwise Amritsar would always be affected, but we know that it is only now and again that malaria at all approaches the proportions it did last year.

The extraordinary and disproportionate exaltation of malaria when rainfall reaches a certain amount suggests the onset of some entirely new influence.

A New Factor.

This new influence can, I believe, be seen at work. If we visit a water-logged area during heavy rain we find not only a large number of pools, but we see the surface of the soil everywhere retaining little collections of water, the furrows in the fields hold water and swarm with anopheles, footprints of man and animals are breeding places, the very high roads retain shallow sheets of water perhaps less than half an inch in depth, which swarm with larvæ. If a house falls down pools may be formed in the debris and larvæ in hundreds may be found in such a situation. There is in fact something very different from a mere increase of breeding places such as we usually understand these to be. There has come about in fact, as a result of complete saturation of the soil, an abnormal state of affairs which enable anopheles to swarm just as when conditions being somehow very suitable, some insect pest occurs in such abnormal numbers as to destroy crops which normally they have little or no effect on.

The essential nature of the condition is, I believe, a biological one.

Anopheles keep their present moderate numbers only because innumerable young are destroyed before they reach the adult stage. It is usual to believe that this destruction is chiefly brought about by various carnivorous insects, fish, and so on. But in the Punjab such methods of reduction must be negligible: anopheles breed in freshly formed rain pools, and so long as these are being formed the species is subject to no effective repression. The one grand restraining influence under such circumstances seems to be the drying up of their breeding places. After every shower in Amritsar during this monsoon there were millions of larvæ destroyed by this means, and a succession of showers at such intervals that their effects disappear before the insects can develop into adults must be vastly prejudicial to the increase in number of the species. On the other hand if we do away with this deterring factor altogether as we do in a water-logged area receiving frequent heavy showers, scarcely any larvæ are destroyed; for even if the pools disappear the larvæ left on damp mud are able to survive and continue their development after the next shower has fallen. It is easy to understand then that the biological balance being upset there is swarming; and that the physical features of the Punjab are very suitable for this biological consummation.

If the view I am bringing forward be correct, the effect of floods is not so

much that the sheets of water are themselves necessarily the direct source of anopheles, but that by water-logging the tract they insure the biological state of affairs I have indicated being maintained so long as any rain is falling. On the other hand, of course, the shallow sheets of water may act directly in the same way. Further investigation, especially of actual epidemic conditions, is evidently needed as well as an investigation of the whole subject of endemic malaria which by supplying the gamete carriers may be an underlying cause of epidemic conditions.

IV.—Prophylaxis of Epidemic Malaria.

I think it is evident from what I have said already that it is as epidemic malaria, and especially in the formation of fulminant areas, that the most disastrous effects of malaria in the Punjab are brought about.

At the risk of repetition I may reiterate the fact that in two months of epidemic malaria as many people may die as in a whole year of normal conditions, and that it is epidemic malaria in a fulminant form which has prevented or minimised the normal increase of population in certain tracts of the Punjab. If we could prevent the mortality from epidemic fulminant malaria we should have removed the most urgent and distressing effects of this disease and those manifestations which the people themselves are most impressed by.

That with a proper organisation we should predict and estimate the proportions of an epidemic at an early stage is an important matter, for we should know in which year special ameliorative measures were most required and could as a result bring these measures to bear from the very beginning of the epidemic with special urgency in areas likely to be most severely affected. And that with a more detailed knowledge of the physical features of the country and of the economical conditions of the people as they relate to malaria, we could predict epidemics with certainty and accuracy is, I think, very probable.

The logical outcome of my conclusions as regards the origin of epidemics would seem to suggest as a remedial measure large drainage projects. Unfortunately epidemics are not confined to any given tract, and may attack almost any part of the submontane or south-eastern Punjab. In 1890, for example, the most intense focus of epidemic malaria of which we have any record attacked Sialkot, an area we should have from previous experience at that time believed to be more or less immune. Under such circumstances drainage would mean that we should have to do what nature has failed to do, namely provide a drainage that will carry off excessive monsoon rain from the Punjab.

Still there remains the question whether certain specially dangerous areas, might not be drained with advantage. There are also towns such as Bhera to be saved perhaps by drainage.

But it is necessary to remember that just as engineers when building a bridge or other work have to consider not the normal rainfall and to allow not for the normal rush of flood water, but for the abnormal, so if we seek by mosquito destruction to diminish epidemic malaria under the peculiar conditions of the Punjab, we must be able to control the breeding of anopheles not during the non-essential ten months of the year, but during the two months or so in which the whole mischief is done, the two months when flood rains fall and water is everywhere, when anopheles are breeding in the furrows of ploughed fields and in innumerable situations where, owing to the impervious and sodden soil, the tiniest collections of water can rest.

So, also, if we carry out large hydraulic measures, we have to calculate on the conditions which produce epidemics, not on those in a normal year when there is no question of flooding.

A case in point is the town of Bhera, which it is proposed to drain by a dyke into the Jhelum. Such a drain in the very year of need will be found wanting, for under such circumstances the Jhelum itself is likely to be in flood, and in one year actually was the cause of the flooding of Bhera and a resulting epidemic.

But even if we decide upon drainage measures as suitable for attacking malaria in the Punjab, it will be very many years before any serious change for the better is effected by this means. In the meantime there is only one thing we can do to save lives in the case of an impending epidemic. The villages themselves cannot, as has been sometimes averred, cope by means of anti-malarial operations with such conditions as I have attempted in this paper to portray.

For urgent treatment of an impending epidemic we have only one efficient weapon to hand, namely, quinine.

But quinine may be used in the prophylaxis of malaria in many different ways, and if we intend to get the best results we must know exactly in which of these ways we intend to use it. The Italians have tried the effect of quinine prophylaxis in the inter epidemic period, and after a trial of many years have come to the conclusion that it is useless to try to prevent an epidemic in this way. Their remarkable results in mitigating the mortality from malaria are due to quinine prophylaxis during the time of the epidemic.

We should take a lesson from their experience. Strictly speaking, to meet the conditions we are referring to, it is not quinine prophylaxis but quinine treatment we are in need of. The ideal of a successful organisation to meet the epidemic malaria of the Punjab would be that every family was taught to know the value of quinine to cure fever, that they were able to get quinine, and by this means to save themselves not only from death but from the effects of untreated malaria. We must not confuse methods suitable for small communities with those suitable for large populations, or forget that in attempting to reduce mortality in India we are proposing to undertake a task infinitely greater than anything of a like sort previously attempted in any part of the world.

The following discussion ensued :—

Colonel King said that Captain Christophers had treated the matter in an exceedingly scientific manner, but it was necessary to remove oneself from the glamour of his methods and to test his results from a practical point of view. Captain Christophers' paper led one to think that the question of drainage was going to have a happy ending, but in the manner of some novelists he had killed off his hero. So long as there was a continuous sheet of water on the soil he thought mosquito propagation was not much encouraged and he thought Captain Christophers would agree. Consequently the harm occurred, not when the extraordinary water was on the soil, but when it receded and left pools of water. Captain Christophers complained that in the Punjab nature refused to deal with rainfall above a normal average, but this was merely a question as to the rate at which it went, as a large or small body of water would go by the same route. One was sent back, therefore, to the condition which Ross recognised of pools in the neighbourhood of dwellings. He next referred to the point which had been touched upon that although in certain years there had been an increase in the rainfall there had been no increase in malaria, and *vice versa*, and here the investigation stopped with a suggestion of mystery. But as a matter of fact there was in operation in the Punjab no mysterious influence directing the occurrence of epidemics. These apparently depended upon well recognised laws. Some of the maps on the wall showed that rainfall was irregularly distributed. This being so, if the Punjab was an area that was subject to change in the course of the rivers, as he understood was the case, substreams would be formed in definite directions, and it followed that the point to which the subsoil water might rise in one year might not be due to rainfall in that area but to distant rainfall, and these facts sufficiently accounted for the variations in endemic and epidemic malaria in localities perhaps distant from each other. In short the paper showed that Captain Christophers had reached a point when an investigation by medical and sanitary experts should have been allied with that of an expert drainage engineer. The "epidemic tongues" to which Captain Christophers had referred were really the old beds of rivers, and in certain times of the year and in certain years the water level of these appeared on the surface. The tongues were originally formed by diversions of the river and diversions probably are formed by clay beds. Consequently in many cases it should be possible for an expert drainage engineer to overcome such obstructions by piercing them so as to reach suitable points of outflow, or in cases where such expenditure would be feasible even by pumping above the point of obstruction. Thus water supplied from subsoil sources might often prove of benefit indirectly by depressing the subsoil water level in such areas. [The speaker was proceeding to illustrate his argument by referring to the situation in Cuddapah when the President drew his attention to the fact that he had exceeded the time-limit.]

Mr. Ferard asked with reference to the point regarding the mortality of children, if Captain Christophers could give information on the following point

which was raised by Major Robertson, the officer on special duty in the United Provinces: "Why is it that a native child infected with two or three different types of parasite will, on getting an attack of fever, very often show in the peripheral blood only one type of parasite and at the next attack may show another type? I used to think that the majority of infections were simple, but more and more I am coming to consider the rule is just the opposite, that infection with more than one type of a parasite is the rule and not the exception, even though clinically and by cursory blood examination the infection may appear simple."

Captain Christophers agreed that a large number of children have double infection or even triple infection.

Major Donovan asked what species of anopheles had been noticed by *Captain Christophers*. It was very interesting as regards these epidemics of malaria that they did not occur everywhere. In the Madras Presidency they had no such epidemics. Then, again, why did they occur in the dry regions, for instance, in the North-West Frontier Province and in parts of the United Provinces? Is epidemic malaria found in Rajputana and Sind? The problem of the swarms of mosquitoes was analogous to that of the swarms of locusts which occurred in dry regions and the conditions requisite for swarming might be similar.

Mr. Ferard said that in 1908 the epidemic in the United Provinces was carried down as far as Muttra.

Major Wilkinson said that in the chapter on Intense Malaria, *Captain Christophers* had used the following words: "Using scantily infected mosquitoes, even in large numbers, it was difficult to get a severe infection; single, heavily infected mosquitoes, on the other hand, often gave quite severe infections." It seemed to him that when there was a large number of infected mosquitoes, then there were present all the conditions required for an intense outbreak of malaria, and it was not necessary to have an intensely infected mosquito. Was it possible to prevent an extraordinary development of the mosquito? If circumstances pointed to a large epidemic of malaria was it possible to deal with the mosquito in any form? How do the epidemics start on the supposition that an intensely infected mosquito was required to begin with? At the beginning the children from whom the infection was derived were not particularly infected with malaria. He was very much disappointed that *Captain Christophers* did not suggest some measures. He drew attention to the fact that these epidemics were of very sudden occurrence and rose suddenly at a high rate. For this reason he thought one should be prepared with measures of some kind.

Captain Christophers said that the fact that epidemics appeared so suddenly suggested that many heavy gamete carriers existed previously. These were largely found among poor and squalid communities in Indian towns and villages. Colonel King's remarks that the harm occurred not when the extraordinary water was on the soil but when it had receded and left pools, were not in accordance with the facts.

Major James considered it very desirable for the Conference to come to a decision regarding the necessity of investigating the epidemiology and endemio-logy of malaria in every province. *Captain Christophers* had begun his paper by saying that malaria in the Punjab presented certain special and peculiar features and the trend of the discussion seemed to show that this point should be emphasised. From the results of the Punjab investigations we are not entitled to generalise and to say that similar factors are at work in producing severe malaria in other provinces. Indeed we know, for example, that while in the Punjab intense epidemics are the result of floods, such floods commonly occur in Assam and other parts of India without causing malarial epidemics. So far as investigation has at present gone it teaches that in each malarious tract of India there is a prominent epidemiological factor, but that this factor is different in different tracts, so that until we learn for each tract the factor of most importance we shall in our endeavour to combat malaria constantly commit errors which may be of great magnitude. It is evident, therefore, that if we are to succeed in our endeavour to mitigate malaria we must first know thoroughly the story of the disease in each province, and every new detail added to this story will be a new weapon by which the disease can be fought. It is very desirable, therefore, that arrangements should be made for epidemiological investigations in every province and it would be of great advantage if the results of these researches could be collected together and published in a connected manner every year as is done in Italy.

The President asked Major James to prepare the draft of a resolution embodying his suggestion.

Colonel Lukis, referring to Major Wilkinson's remarks to the effect that Captain Christophers had made no suggestion for measures in rural areas, read a passage from the "Pioneer" which contained a copy of a letter from Major Ross. He asked Captain Christophers whether he had dealt with rural areas.

Captain Christophers replied that his paper was concerned almost entirely with the conditions of epidemic malaria in rural areas.

He also said that Colonel King had objected to certain points in his paper in connection with rivers carrying off flood water; all he meant was that any scheme to carry off flood water in the Punjab must be something of an extremely gigantic nature. Colonel King's other point made one realise how great was the difference between endemic and epidemic malaria. The difference might be because in the one case, although anopheles were present, they were not present in swarms. In the Punjab they swarmed more largely than in other parts of India. This condition of affairs was not connected with a limited number of pools. In reply to Major Donovan's question as regards the species of parasites discovered, he said that they were chiefly Benign Tertian and Malignant Tertian. The species of anopheles mostly in evidence were *A. rossi*, and *A. culicifacies*.

The President explained why it had been necessary to discuss Captain Christophers' paper before discussing measures. It seemed to him that adequate knowledge of the chief conditions associated with the appearance of epidemic malaria and a knowledge of why, for example, heavy rainfall in one part of India produced intense malaria while in another part it had no such effect, were essential preliminaries to the discussion of measures. He did not think that the great difference between the prevalence of malaria in Burma and in the Punjab could be accounted for by differences in rainfall and drainage, and he attached great importance to what Major James had said that it was most desirable that this Conference should recommend endeavours to investigate more fully this subject of the epidemiology and endemiology of malaria. All measures of drainage were very expensive; it was also known that quinine prophylaxis, if not expensive, is very difficult, more difficult indeed than drainage. In the course of investigations other measures might be discovered which were not open to financial and other objections.

The discussion upon measures was then begun.

Mr. L. M. Jacob said: Sir Harold Stuart has asked me to say a few words on a matter which he thought might interest the Conference.

I have been a Punjab Irrigation Officer for many years and my acquaintance with the Punjab has been wherever there are irrigation canals, and not merely where there are canals in actual operation, but where canals have been destined to be made. My general experience has been that wherever there has been over-irrigation, leading to water-logged soil, malarial fevers have been very pronounced, and the health of the people in those parts has been in marked contrast to that in the desert and more arid tracts of the province.

I would instance the case of the Western Jumna Canal in the south-east Punjab. This is a very old canal, dating from the 15th century, which from the time when it was taken over by the British Government has been gradually improved into its present state. The old canal crossed every drainage in the course of its alignment, sometimes it even ran in the drainage, its supply was in excess of the needs of its commanded area, the country that it irrigated was too freely supplied with water, and these circumstances led to lamentable results, the fertility of the soil being greatly impoverished and the health of the people most injuriously affected. The mass of the inhabitants of the tract had enlarged spleens, which, I understand, was the result of malaria, and it was said that the men were becoming impotent and the women sterile.

The new canal nominally released the drainage lines, but really did nothing until the question of opening out the many blocked drainages was seriously taken up. The subject was one of some difficulty as the drainages ran largely through valuable rice and sugarcane lands, and any scheme of deep drains would have been both very expensive and very unpopular on account of the land it would have been necessary to acquire. The system I proposed, and which was approved by Government, was to clear all the arterial lines of drainage to a suitable outfall

by means of very shallow saucer-drains, without the acquisition of any land other than that required for the one large outfall channel. It was necessary to arrange that the village tanks should maintain a sufficient supply of water for watering the cattle and for domestic purposes, and in carrying this out the villagers concerned were asked at what level they wished the water in the tanks to lie at the close of the monsoon season. Between the tanks the drainages were cleared of all natural and artificial obstructions, such as watercourses, and graded to suitable slopes. I explain this by the diagrams I proceed to draw. The cross-sections were arranged as in this sketch, the soil was spread in a thin layer over the adjoining ground, and on the completion of the works the land remained the property of the original owners who were free to cultivate it. In this way, much swamped, but otherwise valuable land, was reclaimed, and heavy rainfall was enabled to pass on, along the natural depressions of the country free of obstruction, to an outfall, and at very small expense. The people were so satisfied with the system that in many cases they paid for the clearance on the same system of minor lines of drainage.

I should like, however, to explain that the complete amelioration of this tract was only arrived at when, in addition to the clearance of the drainages, we also extended the scope of the canal and brought a large additional area under command. The extensions led to a far greater economy in the use of water. Irrigation in itself, properly managed, need not lead to any water-logging, it is only when water is used greatly in excess of crop requirements that in addition to supplying the necessary moisture to the crops it enters the sub-soil and raises the spring level to an undesirable degree. I believe I am correct in saying that the conditions of both the health of the people and of the soil have vastly improved since the above operations were carried out.

Major Wilkinson: I am acquainted with the Punjab and can say that the canal district has certainly improved.

Colonel Bate: Yes, it has improved.

Mr. Jacob continued: In the Amritsar district, where the Bari-Doab Canal has also over-irrigated the land, a scheme is under investigation for supplying water in irrigated areas by means of pumping from the sub-soil. The advantages of such a process are very great, the land and the people are suffering for the same reasons that the old Western Jumna tract suffered. The soil is becoming water-logged and the spring-level has risen to within a few feet of the surface. Over-irrigation by flow from the canal can only intensify the soils; but if the necessary supply of water can be obtained from the water-table below the surface, crops can be grown as before without the natural consequences of a swamped or sodden country, and the water saved from the canal can be led to where it is most essentially required. I believe that more restricted irrigation and the opening out of the natural lines of drainage will improve the conditions of all malaria-stricken, over-irrigated canal tracts in the Punjab, in the same way that the action taken in the old Western Jumna country proved beneficial.

Colonel King then read the following section of a report which he had prepared for the information of the Conference :—

The difficulties which beset the practical application of Anti-Malarial Measures, by Colonel W. G. King, C.I.E., I.M.S.

One of the first questions that naturally would occur to the mind of the enquirer is as to whether sufficient attention has been paid by the various Governments of India and their sanitary officers to the importance of anti-malarial measures, especially subsequent to Major Ross's important discovery. My experience extends only to Madras and Burma. As already stated, in Madras, in 1900, special exhortations to all local bodies were issued as to "mosquito brigade" methods. By 1904, preparations were made for an extended campaign on principles advanced by me and definitely approved by the Government of Madras (G. O. No. 917, Local and Municipal, dated 2nd August, 1904), in which mosquito brigade work and the issue of quinine occupied an important, but minor position, and the special necessity for radical cure by minor sanitary engineering works was particularly impressed upon local bodies. For this purpose, not only were Sanitary Inspectors already qualified in sanitary engineering to be employed, but over

these were to be Assistant Surgeons trained in minor sanitary engineering, under whose orders Public Works Department subordinates were to be appointed. Why this excellent scheme has not proved more successful in practice is a matter that furnishes experience which I hope may be useful to this Conference. In Burma, in 1902, Colonel Little issued special instructions to local bodies encouraging the formation of mosquito brigades. In the same year, that officer instituted amongst the Military Police the prophylactic use of quinine and the employment of mosquito nets in the hospitals of that force, as well as in the civil hospitals of the province. Attention to this matter was likewise given by Colonel Macrae, his successor. Within a few weeks of my arrival in Burma, I received special orders from Sir Herbert White, the Lieutenant-Governor, to investigate certain highly malarious localities and report on suitable anti-malarial measures. The Government of this province has also given every possible encouragement to the sale of quinine, the better sanitation of malaria-bearers represented by the Military Police, and the formation of mosquito brigades in towns. This province also possesses a Commissioner (Mr. Houghton, I.C.S.) through several years in charge of the large Tenasserim and Arakan Divisions, who has toiled incessantly to promote anti-malarial measures, in which he has strong belief. I have been succeeded in Burma as Sanitary Commissioner by Major Williams, I.M.S., whose enthusiasm in all sanitary matters is widely known. Civil Surgeons who are also Health Officers of their districts have not failed in their attention to the subject. With this obvious willingness of both Governments under which I have had the honour to serve, and distinctly every wish on the part of their sanitary officers to aid anti-malarial measures, it may well be asked why I cannot to-day point to any locality in which it may be said malarial fever has been absolutely extirpated.

What are the difficulties in practice which have prevented the accomplishment of hoped-for results? It stands to reason that the enormous strain upon the resources of local bodies who, in late years, have been afflicted with plague, has not only done much to divert the total energy and staff at disposal, but the finances—without the existence of which no advance is possible. Together with the weary struggle against plague, the introduction of water-supplies, drainage works, conservancy and house improvement schemes have necessarily demanded much attention in a country, which, in many parts, admittedly has been obliged to commence sanitary efforts, within the last few years, *ab novo*. So that if startling testimony as to the efficacy of anti-malarial measures is not forthcoming, we are at least able to meet at this Conference with experience gathered in various parts of India of the difficulties that must be encountered even in normal times; and hence, should be able to make suggestions to meet them. In this sense, I would proceed to deal with the applicability of various recognized anti-malarial measures.

Mosquito brigade methods.—Efforts under this head form but another of the numerous pleas that can be advanced for the existence of an organized sanitary staff that shall not consist solely of advisory medical officers of health, but shall possess correctly educated and skilled executive staffs sufficiently strong to be absolutely in touch with the people, and the necessities of daily and routine sanitary care. The Madras Government, as far back as 1894,* rose to the occasion and now possesses a large and correctly educated executive sanitary staff that but awaits the better development of its higher branches to render it an absolutely effective organization. In 1895 the Government of India† propounded a sanitary organization scheme, which apparently most Local Governments did not adopt. By 1907, the Government of Burma also proposed a definite sanitary organization, of which the main feature was the education of men as provincial Sanitary Inspectors, under the control of correctly qualified Health Officers. Subsequently, and, in the same year, the Government of India circulated proposals to all Local Governments in the hope of evolving a sanitary organization scheme. We approach 1910, but no sanitary organization yet exists in Burma; and I think this is the case in most parts of India—at least in respect to the all-important factor of a specially educated executive in proportion to the population treated. To such staffs then, and not to spasmodically enlisted “mosquito brigades,” should palliative methods be relegated

* It has been frequently asserted that action by the Madras Government was due to the valuable suggestions made at the Indian Medical Congress of that year. This is not the case. A definite scheme for training and employment of Certificated Sanitary Inspectors was sanctioned prior to that Congress.

† Government of India, Home Department, No. 11—313-326, dated the 26th October, 1895.

as a part of routine sanitation. Anti-malarial efforts of this minor class, I conceive, should be recognized and practised as adjuvants even in the presence of accomplished radical anti-malarial measures for many years.

Quinine prophylaxis.—So long as radical measures have not been adopted, quinine prophylaxis must be regarded as of special importance in dealing with jails, and disciplined bodies of military police and troops. That the people may ultimately use quinine largely for prophylactic purposes is a pious hope that has possibilities in it; but it stands to reason that so long as a population is free, this measure cannot be looked to for the extermination of malaria. An essential point for encouraging the sale of quinine is that the Governments concerned, when placing quinine at the disposal of local bodies, should give it at the actual market rate and not at probably what is the cost of production. Such loss as must occur should be contemplated with equanimity.

To control the malaria-bearing policeman, who must be a very real factor in the spread of malaria in a country where *quasi*-military precautions are necessary in respect to transport of treasure, it is apparently sufficient in Burma that the interest evinced by the Government and by the Inspector-General in administrative charge of the large military police force there, should continue; so that the present anti-malarial measures of improvement of outposts, of localities on the routes of escorts, prophylaxis by giving quinine, the use of nets, &c., may be systematically pursued.

But careful legislation would be necessary to throw upon the employer anti-malarial measures for the protection from infection of collections of coolies. Examples of such legislation exist in Italian law.

Dry zones and removal of dwellings.—The removal of dwellings may obviously be a radical anti-malarial measure if the distance of removal from an infected centre be sufficiently far, and, especially if it be accompanied by the adjuvant measure of quinine prophylaxis in respect to persons so moved. Equally so, enforcement of dry zones may be a radical measure, if within that zone palliative measures be also adopted. Failing these, if used alone, the dry zone must at least be classed as a valuable palliative; unless the configuration of the country be inimical, and the control of surplus moisture be impossible without engineering measures, in which case its application would be useless.

In these measures, the difficulty is encountered of vested interests in property being involved, and their practicability must be considered on the usual sanitary lines that the resulting good to the majority must be indubitable, when alone the minority may be called upon to suffer. As to the class of places where dry zones would be of utility, there must be no confusion between zones made on the ground of general health and those required for anti-malarial purposes. The fact that the fever present in a locality is really malarial and affects the prosperity of the people, should be definitely proved as a first step before advising the use of a dry zone.

It is not necessary within dry zones to prohibit any form of cultivation in which the moisture required is not in excess of the absorptive power of the soil. To place water at disposal for cultivation of this class within a dry zone, it is necessary to either arrange for a definite velocity of streams with trimmed edges, or employ well-jointed pipes or impervious conduits for delivery. Wells within the zone should be provided with covers, and, preferably, pumps be employed.

Borrow pits.—In the Madras Presidency, by a Government ruling, the Public Works Department is prohibited from allowing borrow pits to be made within certain distances of villages, and their drainage is enjoined. It is, however, necessary to restrain, by legislation, railways and general contractors from making borrow pits without providing for their correct drainage. Railways are apparently compelled (chiefly in their own interests) to provide for waterways in running their embankments across drainage gradients; but such rulings should be enlarged, so as to secure that not only the safety of railway lines but of the neighbouring people from possible malarial outbreaks is assured.

Radical measures.—In these measures, as already defined by me, I would include all engineering efforts for subsoil drainage, embankments, silting and other methods of bringing about correct control of surplus moisture on soil. The actual works necessary of this nature in a locality, as a fact, may be extraordinarily few; although, in their absence, complete anti-malarial results cannot be hoped for. It must at once be recognized that special funds would be necessary besides a special staff for their execution. Hence, whilst those measures classed as palliative should be looked for from the ordinary sanitary staffs of local Bodies, I think, not only special legislation giving powers to Local Governments is necessary but that special anti-malarial

funds must be found. It is beyond my function to suggest whence funds can be obtained; but unless this Conference is to be a mere stop-gap in the sanitary history of India, they should be definitely forthcoming. Such funds should be so provided that they cannot be diverted to other possibly urgent sanitary requirements. Steadily and uniformly, year by year, radical anti-malarial schemes should be worked out in full detail, be funded, and be executed.

What should be the nature of the staff advising Governments as to radical anti-malarial measures? I am sure that to most officials, the answer to such a question would present no difficulty whatsoever. It would be stated that it would be for the Sanitary Commissioner, in consultation with local authorities, to advise a scheme in sufficient detail for his intention to be correctly interpreted, and if funds were duly provided, the Public Works Department would, in due course, see to its execution. To me, however, the matter presents no such simple solution; and if I indulge in some plain talking on this point, I hope it may be understood that I do so with the conviction that unless some better method were devised than this, in 99 cases out of a 100, schemes would never go beyond the files of offices. The first difficulty to be overcome is the very obvious one that all sanitarians are not engineers, and all engineers are not sanitarians. In conducting anti-malarial measures, therefore, one Department must be in control of the other. I may be biased; but it seems to me that there should be no doubt whatsoever that, up to the stage of execution, the engineer about to attempt sanitary works should be under the control of the sanitarian. Hence, I would not relegate anti-malarial measures *in the stage of evolution* to the ordinary officers of the Public Works Department. In their hands, or in those of private contractors, works might be executed; but, for the evolution of a scheme, there can be no question that the ordinary official engineer is not suitable. I say this, I am sure, without risk of giving offence to the learned and highly skilled body of engineers to which India owes so much. On the opposite, my meaning only emphasizes the truth that engineering is no petty science, but embraces specialities which are day by day increasing. In this, the analogy is found in the case of the medical profession. Were a medical man to require a second opinion on a subject of any importance, he does not think of going to the general practitioner, but he consults a specialist—that is, a specialist in the now alarmingly numerous branches of medical and surgical work. Of course, the general practitioner can become a specialist just as the engineer may, with time and opportunity, become a specialist in electricity, in sewerage, in water-works, mining, ship-building, &c. I do not suggest that the development of the specialist engineer means the ripening of experience at the cost of public funds, but if my analogy is correct, it is worth remembering that the eye specialist is popularly credited with gaining his skill at the cost of a “hatful of eyes.” In short, the general practitioner engineer cannot be taken at a moment’s notice and converted into either a mining engineer, or a successful irrigation or drainage engineer. Hence, for dealing with anti-malarial measures, there must be special appointments under Local Governments of drainage engineers properly so called, to the exclusion even of his ally the sanitary engineer, whose work overlaps the subject of drainage; that is, *men are required who have learnt their duty practically on large drainage works in other countries*—not men who having been general practitioners in a province, because they suddenly show an interest in one or other of the subjects involved, are ordered to fulfil special functions. Such selected men should be subordinates to the Sanitary Commissioners of provinces, and be absolutely at his disposal; but it should be required that a method of free inter-communication should exist between the Sanitary Commissioner and the Director of Agriculture as to the agricultural aspect of anti-malarial questions, and the local civil authorities in respect of the financial aspect of revenue. Under the care of the Sanitary Commissioner, thus aided, plans and estimates for anti-malarial works should be estimated for down to the last detail. But such a solitary specialist whom it is presupposed would be provided with a suitable office and field staff, would not suffice for overtaking many of the minor demands in provinces. Hence, the necessity for an imitation of the same scheme in each district. Each district should have its Health Officer on the staff of the Sanitary Commissioner in close communication with the Civil Surgeon, although, only in certain details, subordinate to him. Under this officer, there should be not only a staff, in proportion to the total population of the district, of certificated Sanitary Inspectors trained in minor sanitary engineering, but, under his special orders, there should be not less than one capable Public Works Department upper-subordinate and draftsman. Thus provided, a Health Officer could evolve numerous minor radical schemes, and, in communication with

the local authorities of districts, and at the cost of the local funds, make year by year steady progress. Under such a simple organization therefore, it will be seen that all palliative anti-malarial measures as well as radical measures requiring but minor engineering efforts would come under the control of local authorities, whilst for the execution of larger works demanding provincial funds, their consideration would pass into the hands of the Sanitary Commissioner, provided with a special engineering expert, and their execution would depend upon the resources accumulated in the anti-malarial fund.

In describing progress of anti-malarial measures, I alluded to the fact that the Madras Government had, in an Order dated the 2nd August, 1904, No. 917L., practically approached this method of dealing with anti-malarial measures. Why it failed at this crucial point is beyond my knowledge, although I viewed the matter with regret at the time. I can only suppose that too much was expected from the funds of local bodies, whilst the Government itself, as the only alternative, had no provincial funds to offer for recurring charges for staffs. The result, however, was that Assistant Surgeons after a course of sanitary engineering have been appointed as Health Officers of districts at the option of local authorities, and are expected to be paid by local bodies; and this being so, their legal control passes to the paying authority. To this the difficulty is added that local bodies fail to see that unless Public Works Department subordinates are placed at the disposal of the officers, their sanitary labours could rarely rise above the results expected of Sanitary Inspectors. For the organization, I have portrayed, therefore, to be effective, there must be nothing left to volition on the part of local authorities. A sanitary organization, such as is held by the Government of the province concerned to be suitable for each district, must be put definitely into existence, and preferably should be a provincial body subject to the authority of the Sanitary Commissioner; and whether the Sanitary Inspectors' grade belongs to the provincial service or not, it seems to me quite clear that the superior grades of Health Officers should be so. With an organization of this description, not only could anti-malarial measures be undertaken vigorously, but there would result a general advance in the sanitation of the country.

General lines of legislation for removal of existing difficulties.—In the enforcement of zones, the interests of private individuals alone are not affected—the resources of Government largely depend upon the revenue product of irrigated lands, and not until the mineral and industrial resources of India have been greatly developed can such loss be regarded with equanimity, even if, as I contend, it is possible to localize the great centres of malaria, and thus minimize resulting financial questions. Hence, in dealing with dry zones, one has to contemplate the loss of revenue in perpetuity to Government, and the necessity of meeting the losses of private individuals by monetary compensation. This should, when possible, always be the difference of the profit accruing between wet and dry crops. Unfortunately, in Burma, it will take a long time for the cultivator to receive such a system. If he be not allowed wet cultivation, he will not cultivate at all. Hence, outright purchase must usually be contemplated.

To meet these requirements, expansion of existing legislation is necessary, and recommendations on this subject by the Conference would seem to be essential. A recommendation as to minimum size of zones would have to be approached—based on the still uncertain existing knowledge of the length of flight of the mosquito, and practical experience of their efficacy. So far as I can see, although sanitarily it would sound illogical, it would be but reasonable, in view of financial necessities, to desire that zones should recognize grades of protection, having regard to the size of the population concerned. For full protection, I think the size of a zone should not be less than one mile.

Practical experience shows that legislation for important anti-malarial measures must not be merged in existing Acts administered by local bodies. It is a hopeless matter, for example, to say that a zone shall be confined to the whole of a municipal area. This sounds well; but, in practice, it may exclude lands under a rural local body within the striking distance of the mosquito. Further, such legislation must be accompanied by rulings that, whilst not crippling other forms of cultivation classed under dry and garden, shall hold them in such control that the tenant shall not place upon the soil more water than it can absorb, or permit it to run to waste without definite and final disposal.

I would specially commend to your notice the necessity for legal measures that shall ensure that, in localities recognized as malarious, no new wet cultivation shall be conducted without the owner furnishing a record in which shall be exhibited

not only the means for bringing water on to the land but taking the surplus off. It is not, in my opinion, the mass of water which passes over the land for irrigation that one need fear so much for mosquito propagation, as the absolute apathy with which both the cultivator and all authorities concerned view the careless formation of pools and puddles, after the water has fulfilled its function. Plans for major irrigation works also should not only take note of how the water is to reach land to be cultivated, but also how it is to be removed therefrom.

Further, whether or not it would imply gain to Government to ordinarily use, such methods in the supervision of irrigation as shall lead to cultivators using no more water than really is required under irrigation systems, it should at least legislate that in malarious areas special measures of control should be adopted by officers responsible for water distribution.

Rulings are also requisite for the removal of dwellings likely to impair the perfection of zones, as, necessarily, these should have their measurement from the most external dwelling of an inhabited area. The removal of houses liable to be inhabited by persistently infected individuals from the neighbourhood of bodies of disciplined men and Government institutions, would also seem reasonable. In urban areas, provision for throwing upon the tenant, or owner, the onus of maintaining the premises of dwellings in a condition that shall facilitate palliative measures, or, failing such precautions, would enable the local authority to act summarily, would demand expansion of existing rulings. The sanitary care and prophylaxis of large coolie gangs recruited from malarial regions and imported into distant localities also demand special legislation. Such measures should also indicate the cheap provision of quinine in highly malarious areas for the general public, and aid by the medical and sanitary staff of public bodies at the cost of the employer of large coolie gangs. The making of "borrow-pits" must be subject to rulings appropriate in respect to locality.

Summary of measures advised.—To summarise therefore, I would advise that to meet the present demand for greater activity in anti-malarial measures in India, the following are the requirements :—

(1) That "mosquito brigade" and other palliative measures, together with supervision of systems for cheap provision of quinine for the general public, should be regarded as coming within the scope of routine duty of a correctly organized Executive Sanitary Department, the existence of which is essential in the health interests of the country;

(2) That these measures should be combined with quinine prophylaxis and mechanical protection from mosquito bites wherever feasible with due regard to toleration of individual and personal liberty, wherever disciplined bodies of men are dealt with;

(3) That coolie labour is an important factor in dissemination of the causative agent of malarial fevers, and that special rulings to secure the use of anti-malarial measures, consistent with reasonable liability of employers, the liberty of the subject, and the importance of the body of coolies in respect to numbers, are necessary for its control;

(4) That although diffusion of malaria occurs from time to time under specific conditions, especially by transfer of labour, it is eminently a disease of localities, and that consequently *radical* anti-malarial measures should be directed against the great centres of malaria prevalence, in the interests of the rest of the country;

(5) That in the treatment of these great centres whilst no palliative or prophylactic measure should be neglected, radical results can only be looked for by engineering measures directed to the control of surplus moisture on soils;

(6) That whilst all palliative, prophylactic, and minor radical measures may safely be delegated to a correctly organized Executive Sanitary Department under local authorities, efforts directed against the great centres of malaria prevalence should be organized as follows :—

From sources to be ascertained by local Governments, each province should form a cumulative "Anti-Malaria Fund," which should be devoted solely to expenditure incurred on the extermination of malaria, by radical measures involving the control of surplus moisture.

The local Governments concerned in respect to these measures should be advised by the Sanitary Commissioner of the province, who should be aided by an expert Drainage Engineer, provided with suitable field and office staffs, for the preparation of detailed plans and estimates.

The detailed plans and estimates so prepared should pass to the Government

concerned through the Sanitary Board of the province; but, in the event of the Sanitary Board or the Secretariat officers of the Public Works Department or other officer consulted by Government, advising the rejection of certain portions of schemes of an expert sanitary or expert drainage engineering nature, such difference of opinion may be referred by the Sanitary Commissioner of the province to the Sanitary Commissioner with the Government of India, who should place the matter before the Sanitary Commissioners and Drainage Engineers of at least two provinces, and the Government concerned shall then be definitely guided in its decision by the opinions thus gained on the particular expert point raised.

(7) That a Special Anti-Malarial Measures Act for India is necessary, which should be capable in part or whole of being applied by local Governments to highly malarious areas, and of being in part incorporated with, or withdrawn from, existing Acts administered by local bodies.

The following paper was then read :—

*Malaria in Cantonments. "Wanted a Policy," by Lieutenant-Colonel
H. B. Thornhill, C.I.E., I.A.*

In common doubtless with many other officers whose duties are connected with the sanitary condition of Indian Cantonments and the health of soldiers and others therein, I have been struck by what appears to be the unsatisfactory line of action that is at present adopted with regard to the prevention of malaria. While this is obviously due in great measure to our lack of definite knowledge regarding the best methods to employ, the present line of action exhibits, I venture to think, some fundamental errors to which it is advisable attention should be drawn.

It seems to me that the most striking of these is the fact that the tendering of advice upon the subject of malaria prevention in Cantonments, is not confined to a few officers, who from study and experience are qualified to be regarded as experts, but is the common practice of almost everyone who is connected, either closely or remotely, with the Army in India. The result of this flood of advice by irresponsible persons is the receipt by the authorities who have to find the money for the schemes, of numerous recommendations that are unpractical, impracticable, and futile. An instance that is neither worse nor better than many others, is afforded by a perusal of the Sanitary Officers' reports for 1908, where in regard to Peshawar, it is recommended that—

- (1) all irrigation should be stopped in or near British and Native lines;
- (2) all the ground should be levelled and drained where necessary, which must mean throughout the Cantonment;
- (3) all cultivation should be forbidden in the vicinity of barracks;
- (4) Regimental bazars should be reduced to actual requirements and placed "at a safe distance" (whatever that may mean) from the lines.

Recommendations couched in similarly drastic and equally general terms are very frequent, and I believe I am not wrong in saying that on the few occasions when an attempt has been made to carry them out, the result has been a great expenditure of money and the conversion of the station into a wilderness, but an absence of trustworthy evidence that mosquitoes and malaria have been markedly reduced.

But it is not only in regard to the problem of recommendations and advice that I think our present line of action is at fault. I think we fail also in regard to the application of the anti-malarial measures that are at present most usually recommended. I refer to the fact that in all, or in nearly all, the cantonments in the plains it is now the rule to make an attempt to destroy mosquito larvæ, and to give quinine prophylactically. I am not competent, of course, to express a definite opinion to the effect that these measures are not in all cantonments necessary, but from a personal working knowledge of local conditions in most cantonments in India and Burma, and from a study of reports and statistics, I gather that in the first place some cantonments are not at all malarious, and in the second that a number of malarious cantonments are so situated that any attempt to limit the number of malarial mosquitoes must be quite useless. Again, I find it noted in the annual report of the Sanitary Commissioner with the Government of India for 1902 that "at Bellary, Shwebo, and some other stations, the medical officers stated that no anopheles mosquitoes could be discovered by

careful search, but that kerosine oil was nevertheless used as orders to that effect had been received." The fatuity of adopting measures against malarial mosquitoes when none of these insects can be found seems obvious, and on the whole the opinion appears justifiable that needless waste of expenditure arises from a general adoption in all, or nearly all cantonments, of measures which in the non-malarious cantonments appear to be unnecessary, and in some of the malarious ones appear to be futile.

Looking at the subject, therefore, from the spectator's point of view it seems to me that the present line of action is far from being the best that can be followed. What is wanted is a definite policy, and, if possible, a centralisation of authority, so that research and practical measures can be systematically carried out upon a clear cut-and-dried, pre-arranged plan.

To start with it might be ascertained how much money—

- (a) Government is prepared to contribute, and
- (b) what sums cantonments can afford to subscribe towards anti-malarial measures.

Once this amount is known the whole question resolves itself into the solution of the problem how the money allotted can best be spent.

It is in these days of financial pressure not likely to be a very large sum that Government can give, and it will therefore be advisable to concentrate our efforts, for the present, upon the most malaria stricken cantonments.

Some cantonments are very malarious, others not at all malarious, and it would be absurd, at any rate at the beginning of the task, to spend money upon anti-malarial measures in the non-malarious stations.

When the stations where malaria is most prevalent have been decided upon, the plan of campaign will come up for settlement. To determine the best method of attacking the problem, it would, I submit, be desirable to form a strong central committee of practical men who would be aware of the relative importance of different cantonments, of the amount of money that might be available, and would possess the influence and the driving power necessary to enable any scheme which they approved, to be carried out as quickly as possible. The committee should include among its members, an adviser who has made a special study of malaria in India. When the committee had been formed it would endeavour to obtain the services of one or more competent medical officers who have made a special study of malaria in this country, and it would despatch these officers to the cantonments where malaria is most prevalent, with instructions to report upon them to the committee after consultation with the local authorities. These reports would be considered by the committee, who, if it appeared necessary, might submit them for opinion to any officer whom they considered well qualified to assist in the matter. The committee would then finally decide upon the scheme, which would afterwards be published for general information, and commenced without delay.

Each cantonment is of course a study by itself, and measures suitable for one may be quite inapplicable to the needs and local conditions of another.

The object would be to draw up for each cantonment a clear definite scheme that would meet with the approval of the committee.

It is quite likely that these expert medical officers would recommend in one or two cantonments the carrying out for a year or so of experimental measures. It is far better in the present imperfect state of our knowledge of this subject to spend money upon well-considered measures of research, than to squander it upon ill-considered, half-digested schemes, which might end in failure.

Malaria has been with us for very many years, and a year or two spent in research by expert officers should not be grudged.

It is ridiculous to imagine that this disease can be stamped out suddenly. Any hurried, half-digested scheme is bound to involve a lamentable waste of money, and, incidentally, loss of life.

If the policy which is very roughly outlined above were inaugurated, huge mistakes involving the useless expenditure of large sums of money could not be made, and we should have for each cantonment a definite scheme which could be at once proceeded with on funds being made available. In this respect the arrangements would be similar to those that are made in advance, in the event of war.

One advantage that this plan possesses is that it would automatically stem the devastating flood of recommendations by irresponsible individuals.

Everyone concerned would be aware that such and such was the scheme for such and such a cantonment, and that it was the plan to be carried out without any unauthorised deviations or alterations.

We should be saved the undignified and expensive situation created by inexperienced officers prevailing upon General Officers to attempt some pet scheme of their own, possibly against the experience gained by medical officers who have really studied the subject, and who are fully acquainted with all aspects of the problem in this country.

In the absence through illness of Lieutenant-Colonel Chaytor-White the following paper was then read by Mr. Ferard :—

*Note on the Propagation of Small Fish as a means of limiting Malaria, by
Lieutenant-Colonel J. Chaytor-White, I.M.S.*

It has been known for a long time that fish feed on the eggs, larvæ and pupæ of all kinds of mosquitoes, and this fact has been taken advantage of in many countries for the purpose of keeping down mosquitoes where they are found to be a nuisance. As a rule small fish are more suitable than large for the purpose, because mosquitoes breed in small, shallow pools and shallow places to which large fish could not gain access. Moreover small fish go into the shallows to escape being the prey of the larger fish. Fish that feed on the top of the water are most suitable for the purpose, but any small fish are useful. The United States Fish Commission in 1905 imported to the Hawaiian Islands a large number of top-minnows to get rid of the mosquito pest with favourable results. In the year 1905 a Mr. Kenrick Gibbons propounded the theory that the absence of malaria in Barbados was due to the fact that a small fish called "millions" abounded in streams and ponds in the island, and fed voraciously on the eggs, larvae and pupae of all sorts of gnats and mosquitoes. No anopheles mosquitoes have ever been found in the Barbados, while on the other hand, at the neighbouring island of St. Lucia and at Antigua, where there are no millions, anophelines abound. *Culex fatigans* and *stegomyia* are both found in Barbados, as these two species, as is well known, will breed in small collections of stagnant water as tubs, sardine tins, concavities in trees and other places where millions cannot obtain access. The anopheles mosquito, however, breeds chiefly in shallow pools, streams and swamps. It is certainly remarkable that notwithstanding frequent close communication between Barbados and the neighbouring islands where malaria and anopheles exist, there is no malaria in Barbados, the only island where millions are found. The absence or presence of these fish appears to affect the existence of malaria. In August, 1905, millions were introduced from Barbados into Antigua in a kerosine tin. They arrived in good condition and were kept in a tank and subsequently distributed. At the present time, four years since their first introduction, all the permanent collections of water have been stocked with millions and the planters have remarked on the cessation of the mosquito nuisance since their introduction. In Jamaica they were introduced in 1906 and fever has abated. This small fish, which has apparently acquired the name "millions" on account of the vast numbers in which they are found, so far as is known existed only in the island of Barbados, and has been technically identified as *Girardinus Pæciloides* by De Filippi. They belong to the group of fishes known as top-minnows—minnows that feed on the top of the water. They are very small in size, the full grown female being only $1\frac{1}{2}$ inches long, while the male is much smaller. The female is of dull colour while the male is marked with regular red splashes on the sides and has a circular black spot on each side. They live in shallow water among grass and weeds, and are able to swim against a strong current. They feed on all sorts of animal life, but particularly on the eggs, larvæ and pupæ of mosquitoes. They increase in number very rapidly under favourable circumstances. Strangely enough, unlike most fish, the female does not lay eggs, but brings forth its young alive. They are viviparous. This fact was recently brought to my notice in rather a curious way. A medical officer in these provinces last winter asked his wife, who was in England, to procure some of these fish for him and bring them out to India. They all died but one, which was placed in water in a glass jar. It was thought to be diseased, as it had a very swollen appearance. The jar was unfortunately left

uncovered, and the fish was found later lying dead on the floor, having jumped out of the jar. The medical officer, however, dissected out the fish, and, to his surprise, found it full of young, which under favourable circumstances would have probably sufficed to start the experiment in this country. It is really an advantage that these small fish should be viviparous, for, although the number of offspring from one female may not be so numerous as would be the case were the female oviparous, yet a larger proportion reach maturity as there are no ova to be devoured by predatory fish. The very small young may certainly be eaten, but they have a fair chance of escape.

I need hardly mention how greatly exposed the mosquito is to the onslaught of fish. The insect lays its eggs on the water and is probably frequently devoured while in the act of doing so. The eggs, for several days before they hatch, may be eaten, while the larvæ when moving from the top to the bottom to feed, and back again to breathe, are especially liable to attack. It will be cognizant to all how *chilwa* and other small fish during the monsoon are constantly to be seen jumping and feeding on larvæ in shallow pools near the roadside and in *jhils*. It is probably not so well known what merely a few fish can accomplish in this direction. Last September, when mosquitoes were so bad and fever so prevalent, a gentleman in Agra put a few fish into the swimming bath there, with the result that the mosquitoes that had before been very bad entirely disappeared. Tadpoles apparently have little effect on mosquitoes as in a pool where there were some, anophelæ abounded, while in another pool containing fish close by, no larvæ were found. Frogs and tadpoles do not eat larvæ, though frogs will eat the adult insect.

Habits of feeding.—Millions have frequently been observed feeding on larvæ. They are probably the most active of all the natural enemies of mosquitoes and live for preference exactly in the localities and situations in which anophelines breed. They are most persistent in attacking larvæ, and even very small fish will attack a large larva and keep hold of it till dead. They gorge themselves to distention with larvæ, and will keep hold of a larva if unable to swallow it, until some of the food already eaten is digested and room is made for the latest capture. For most of the information about these fish I am indebted to the Imperial Department of Agriculture for the West Indies.

Propagation.—There is apparently no difficulty in introducing millions into new localities. As above noticed, they have been successfully introduced into Jamaica, St. Kitts, and Antigua. Dr. Chalmers Mitchell, Secretary of the Zoological Society of London, has had constant consignments sent him, and they thrive excellently. I am sorry I have been disappointed in not having yet received a consignment, as Dr. Mitchell writes, under date June 8th, 1909, that his own stock is at present very low, and he has had to deplete it several times recently. The Colonial Office have, however, taken the matter up, and propose introducing the fish into the Straits Settlements, and have now a set of fish under the care of the Zoological Society for that purpose. The fish are easily fed, and with the exercise of a reasonable amount of care can be successfully transported. I am arranging to receive batches, and expect the first to arrive under the care of a medical officer this cold weather.

I take it that in India we cannot hope to do more than diminish the amount of malaria; to stamp it out, in the present state of our knowledge at all events seems impossible. Quinine, drainage, the filling up of pits and excavations and putting kerosine oil on tanks, are all excellent in their way, but we have to face the fact that we have here in India a heavy annual rainfall, and we have also constant excavation of earth going on, especially in villages, for the repair and building of houses.

Malarial conferences hitherto have made a multiplicity of recommendations regarding mosquito extermination. They are costly—almost prohibitively so—if undertaken annually. Ronald Ross in his report on the prevention of malaria in Mauritius gives a list of recommendations for mosquito extermination that is sufficient to appal the stoutest heart and is impracticable of annual application. But nothing is said about the propagation of fish, and I consider that more should be done in this direction in India than has hitherto been attempted.

If we can do something that requires little human interference, that may be said to act automatically, that only requires the distribution of a few fish at the beginning of the monsoon and can then be left to itself to act, we at all events are doing something that does not cause much interference with the people, nor

trouble or expense to a large community. In India we have annually large destruction of fish—the natural enemy of the mosquito. Yearly in the hot weather tanks and pools dry up and the small fish are killed off. These collections of water have to be restocked in the rains, and this is largely accomplished by the “wader” variety of birds that carry on their feet ova and small fry. Undoubtedly a good many varieties of fish burrow into the mud and keep alive throughout the dry weather. But it will be necessary to prohibit the natives killing off the small fish for food purposes, as they now do by netting tanks and pools when they become low. If we have a stock pond in each *tahsil* where fry can be obtained for distribution by *tahsil* chaprasis or others, restocking can be accomplished. I would encourage the breeding of indigenous fish such as *moila*, *kater*, *bhoor*, *rohu*, *tenghen*, *chilwa*, *perhin*, *jhinga*, *singhi* and *anwari* varieties. Top feeders such as the *anwari* (mullet) should be particularly useful for the object in view. All varieties of fish do not feed on larvæ, and Lieutenant-Colonel Giles mentions in his book, “Gnats and Mosquitoes” (page 150), that fish and mosquitoes are found together in the Madras rice swamps, but this is quite exceptional. That acute observer, the late Mr. E. H. Aitken, says in the same place: “From my experience I should say that, of all larvicides, the most effective in the case of anopheles, is little fish. I have never found larvæ and fish in the same pool. Once I put a large number of larvæ into two glass vessels and introduced a few gold fish into each. Next morning there was not one larva in either.”

I suggest that the greater prevalence of malaria after dry years may be partly due to the great destruction of fry and fish spawn that occurs when the monsoon suddenly stops, as it did in 1907, inasmuch as the small pools and breeding grounds dry up, leaving fewer fish to breed in the succeeding year. Owing to the early cessation of the rains in 1907 as well as in 1908, the smaller varieties of fish were probably unusually scarce last year. As I have remarked fish spawn is largely carried on the feet of birds to other pools, and in a dry year this does not happen. The result is that fish are not so numerous as usual and mosquitoes increase and breed in large quantities. I had observations made last year which go to show that mosquitoes in some districts were unusually prevalent.

Anophelines will lay their eggs when hard pressed on very small collections of water or on mud, in which cases, of course, fish could hardly reach them. After all, as I have said, we can only hope to limit the amount of malaria, and anything that can tend in this direction should, I think, be encouraged.

The following discussion ensued :—

Colonel King said that some successful experiments with fish were made at Meiktila by Dr. Evers. He could not give any description of the experiment, but those interested could write to the officer who had conducted it, who was now stationed at Mergui.

Mr. Ferard referred to the question of “millions” spoken of in the paper, and said that in this connection the oiling of tanks had been taken into consideration. He would like to hear, considering the difficulties in the matter, whether it would not be sufficient to oil merely the edge, or whether the entire surface should be oiled.

Surgeon-General Trevor said that as the wind blew the oil all over it was sufficient to oil merely the edges.

Major Rogers said: We have had a number of criticisms on the small amount of good done by anti-malarial measures in India. These works, and especially the failures, have never been put on record, and it is very important that the delegates should give their experience with reference to the measures that have been carried out in order to bring forward lessons derived from practical results.

For the past few years various measures have been undertaken in Bengal, the reports of which have not been made public, but have been placed at my disposal by the Bengal Government. From 1905 up to the present time experiments have been made in Bengal municipalities. On the advice of Major Clemesha, test work was done at Berhampore, the capital of the Murshidabad District, and recommended as being a suitable place. Colonel Nott, the Civil Surgeon, together with the Deputy Sanitary Commissioner, superintended the operations. They were carried out for two years, and it was found that a considerable reduction took place in the number of mosquitoes. The expenditure in two years amounted to Rs. 3,400,

and the work consisted of filling up tanks, hollows, and pools. It was watched carefully, but at the end of the second year the river which flowed on one side of the town changed its course to the other bank and left a large swamp; and this was accordingly held by the sanitary authorities to nullify the efforts made. This is a good example of the difficulties met with in attempting to carry out the proposed measures. Another experiment was made in Jogdispur in Bihar. This is a small municipality with an area of about a square mile. A European planter who took a great interest in the place superintended the operations. There was only a small number of tanks and irrigation channels. In this case they tried *leaping* and tarring the edges of the channels; that was not successful as the tar was washed away by the stream. After two years the experiment had to be abandoned because the mosquitoes were breeding in the rice fields all round. Here again the measures failed. A more continuous experiment was carried out at Ranaghat. It was selected as being a bad fever place, and as being probably the most favourable for an experiment in that part of Lower Bengal. Here the usual methods were carried out of filling up hollows and small tanks, together with oiling, and jungle cutting. These operations were superintended by the Civil Surgeon, and in three years a sum of Rs. 12,000 was spent, two-thirds in filling up pools and hollows. This was popular among the inhabitants, especially those who owned land, and much valuable land was reclaimed in this way. The ultimate result of this experiment was that it had no definite effect in reducing the malaria. There again it was found eventually that wet or rice cultivation, which was found to be the chief breeding ground of mosquitoes, was being carried out within the municipal area. After three years' work the experiment was given up because it was said it would be necessary to carry out a drainage scheme. The drainage scheme is being worked out. At north Barrackpur there was another test, the idea being that as it was near Calcutta, it could be watched. At the end of two years no definite results had been attained.

These are very briefly the results so far, and I think some lessons can be derived from them. It is noteworthy that during this series of experiments no definite data were obtained as to the exact anopheles present which were carrying malaria. This was due to the fact that there was not the same Deputy Sanitary Commissioner two years running—there was no continuity. I wish to say a few words about the distribution of anopheles. My experience is that *Anopheles rossi* breed very largely in tanks in the hot weather, and we know that they have not been found to be malaria carriers. I have found that at the end of the rains, *A. fuliginosus* were breeding in *katcha* roadside drains. These are the chief malaria-carrying mosquitoes which have been found infected in Lower Bengal. Further, *A. fuliginosus* has been found to be infected by malaria both in the Punjab and in Bengal. This being so, it is not the tanks which are an important factor; at the end of the rains there are swarms of small fish in the tanks, but no anopheles. In Calcutta, which is properly drained, we find a large number of tanks but there is no malaria infection. The roadside drains are the important breeding grounds. I mentioned yesterday that long breaks in the rains allow of the anopheles breeding largely. As regards oiling the drains, the experiment was tried and found to be hopeless. At the end of a week there were more larvæ than before the oiling. I believe that in Bengal the question of the permanent reduction of malaria is to do away with *katcha* drains. We want to strengthen Sanitary Engineering, to work out levels in municipal towns; then to construct outfalls, give a grant if necessary for the purpose and extend the system of surface drainage, fill up these drains as much as possible, first in the denser parts of the town and then gradually throughout the whole area. It may be done gradually as funds allow. These permanent sanitary measures will have good effects. We have the example of the central parts of Calcutta, which was intensely malarial less than a century ago. Now there is no malaria there. This I am certain is the important question in towns and municipalities in Bengal.

As regards the question of the drainage of the subsoil, I was speaking yesterday of the deltaic tract where areas are flooded throughout the rains, there harm may be done by drainage. This view is limited to that flood area. In the water-logged conditions that Captain Christophers has described, drainage by permanently lowering the subsoil water is, when practicable, of the utmost importance in reducing malaria.

Then as regards the question of rice cultivation in municipalities in many places in Bengal. We should prohibit this cultivation in the densely populated municipalities. In two of these test experiments anopheles were found in small pools as water subsided. This is a very important point. We should strengthen the

hands of local Governments in carrying out these measures. It must be faced. In Ranaghat rice was only grown in a year when there was an unusual amount of rainfall, and rice cultivation might be done away with there. The essential measures to be adopted are to have permanent surface drains and to prohibit rice cultivation within a certain distance of a town.

Major Donovan explained that in certain parts of the Madras Presidency anti-malarial operations had been carried out but that they were not under proper control and it was therefore impossible to test the nature of the conclusions reported. What was wanted was a stronger staff to control and watch the results. Otherwise all attempts at improvement were likely to be wasted.

Mr. Goswami thought that all anti-malaria operations should be varied according to circumstances. As regards the resolution which had been passed, he quite agreed with Colonel King's suggestion that the expert body of sanitary officers should be associated with men of engineering knowledge and that they should act in co-operation with a view of finding out if certain anti-malaria operations, involving large expense in the way of drainage, &c., were feasible or not. As regards the cultivation of rice near towns, it occurred to him that if people, especially in rural areas, were to undertake horticultural operations or plant fruit trees, they should be encouraged to do so and to give up the cultivation of rice. He would prohibit wet cultivation within municipal areas.

Colonel Dyson endorsed the opinion of Colonel King as to the importance of permanent improvement in the sanitary condition of malarious areas, aided meanwhile by certain palliative measures. Anti-malaria measures should be differentiated into those most suitable for towns and rural areas. In towns what was wanted was drainage schemes, the removal of water that was not wanted, and the like, whereas such measures would be costly, difficult of accomplishment and unnecessary in rural tracts, where quinine distribution would be of more value. In the Bombay Presidency, with the exception of quinine distribution in rural areas, the efforts made had been unorganized and spasmodic and left entirely to the local bodies concerned. There had moreover been a want of continuity. There were therefore few or no results to be chronicled. In Bombay the Sanitary Department was differently constituted to what he understood was the case in various other provinces. Excepting the Sanitary Commissioner and five Deputy Sanitary Commissioners there were no recognized sanitary officers. There were inspectors of vaccination, but they had little or no sanitary training. He would suggest the embodiment of Colonel King's suggestion, or a modification of it, in a resolution. A definite statement should be added as to the staff required for carrying out anti-malarial measures.

Mr. Chaudhri said: The popular notion in the two Bengals is that insufficient drainage and high water level are the principal causes of malaria. I can say from my own experience that the silting up of the Rivers Boirat in Natore, Karatowa in Bogra, and Lohajang and Jheenai in Tangait in Eastern Bengal and Assam are the chief causes of the water-logged condition of these places. Government seem to have accepted the theory of insufficient drainage and was actuated to introduce a Drainage Bill in Bengal. There is a difference of opinion among the experts at this Conference on the subject, and I am glad Colonels Leslie and King are in favour of drainage schemes. I think that instead of an experimental undertaking of the drainage of large areas, the cost of which will be highly prohibitive, it would be safer to undertake the drainage operations of only such highly malarial tracts where the subsoil water condition prevails, the cost of which will not be prohibitive and which do not involve danger to other localities. I may further suggest that railway companies and local bodies responsible for making roads and embankments should be asked to make borrow pits on one side only and not as at present on both sides, and have the pits so dug as to cause a natural flow into the nearest river.

The President, referring to the statement made by Mr. Goswami as to the prohibition of rice cultivation in or near human habitations, said that in his experience it was by no means established that rice cultivation always produced malaria. In the province in which he had served most of his time there were areas where the ground was under water practically the whole year round; he could not recollect that these areas were markedly malarious. He did not think the suggestion made by Mr. Goswami of growing fruit trees would have the desired effect. Before they closed the sitting, it was desirable to arrive at some conclusion on the subject of measures of drainage. But before they could recommend to local Governments or the Government of India the undertaking of expensive measures of drainage, they

should have more information on the subject than they possessed at present. He would therefore propose that they should recommend further enquiry into this subject.

Colonel King said the point was apparently that they should have some practical experience of what was best in India. With reference to what had been said in Captain Christophers' paper the question was, could the subsoil levels be kept within bounds or not. Experience on the subject was derived from various sources. The speaker then went on to refer to statistics given by a certain Board in America and to operations in Algeria.

The President explained that his point was that before any costly undertakings were begun it was necessary to prove that malaria was due to a high level of the subsoil water. He did not think the point had been established.

Major Rogers said: As regards the President's remarks as to rice cultivation not having proved to be harmful, I think it is simply a matter in Lower Bengal of whether rice grows in deep water which does not dry up during the autumn malarious months or whether the rice is grown on high ground, in which case drying up occurs with mosquito-breeding during the malarial season. Thus rice which is grown on high land is most dangerous. Where the land is completely flooded up to late in the year it is most healthy. In Dinajore there is the least malaria when the land is flooded until the temperature gets low, and the danger of malaria then ceases. That is why I consider that in these municipal areas, that is where there is a town population, this matter should be considered. I should like to propose the following resolution: That in municipal towns *pukka* surface drainage is a most important permanent anti-malarial measure, by removing stagnant surface water.

Captain Christophers: In Palwal, which is splendidly drained, there was a mortality from fever last year of 420 per 1,000. In that town drainage did not seem to make any difference.

Major Rogers: That is exceptional.

Captain Christophers: We know so little about these matters that it is difficult to say what is general and what special.

Major Rogers: The parts of Howrah where there is permanent surface drainage are now nearly completely free from malaria.

Mr. Fox-Strangways thought they should avoid spending money on any ill-digested schemes. At the same time, speaking as a layman, he would like to have something as a guide. He would like to support Major Rogers' suggestion that they should have from each province some information as to what had been done either in the way of drainage or anopheles extermination, &c., so as to know on what lines to proceed for the present, pending general operations. In the Central Provinces very little had been done. They had undertaken some measures of town drainage and in Nagpur and Jubbulpore they had allotted sums for out-falls and were gradually working out a system of street drainage. There was a general feeling that there had been an improvement in the health of the towns. In other towns there had been a somewhat half-hearted attempt at anopheles extermination, but there was a general consensus of opinion that mosquitoes had been gradually reduced. Figures showed that there had been a reduction in malaria. He would like information from other Provinces.

Colonel King thought it was necessary to have a definition of what drainage measures were. They had thought too much of subsoil drainage.

Colonel Dyson said that in Bombay Dr. Bentley found that the chief source of infection lay in the wells. It was generally considered that the epidemic of malaria in Bombay was due to recent operations in connection with Port Trust Works. There were undoubtedly large pools of water in which mosquitoes could breed.

Mr. Ferard, in reply to the request for information made by Mr. Fox-Strangways, said that new legislation was being considered on the subject of rural areas to admit of the draining of pools and tanks round villages. It would probably be embodied in the new Village Sanitation Act. As regards town drainage all municipalities had been asked to prepare maps, with a view of carrying out brick or metal drains instead of *katcha* drains. There was also being undertaken the oiling of tanks.

Mr. Nathan thought the Conference should record nothing by way of mandate, but the attention of local Governments might be called to the drainage aspect of the question. Where it seemed possible that drainage would cause the reduction or abolition of infection, then the Sanitary Engineer element would come in and

operations might possibly be carried out, but no general mandate whatever should, he thought, be given.

Colonel King agreed.

Mr. Mudholkar, to show the difficulties that District Boards have to face, gave the instance of Amraoti, where wells were abandoned and a water supply introduced. The health of the town did not improve, the reason assigned being that although they now had pure water to drink there was as yet no drainage system. A scheme of drainage costing about $1\frac{1}{2}$ lakhs of rupees was therefore undertaken, but it was insufficient, and another scheme costing about $2\frac{1}{2}$ lakhs was substituted. Finally a scheme was proposed which was estimated to cost $4\frac{1}{2}$ lakhs. The town had a population of 35,000 and an income of from Rs. 50,000 to Rs. 60,000. If such schemes were to be proposed all over India the cost would be enormous.

Captain Baket drew attention to the fact that in Burma along the railway line and Public Works Department roads there were thousands of miles of borrow pits.

Mr. Cholmeley said this must be a great factor in the breeding of mosquitoes.

Major Rogers' resolution was then submitted to the Conference and accepted pending further discussion on the last day.

FOURTH DAY.

Friday, October 15, 1909.

PRESENT:

Sir Harold Stuart, K.C.V.O., C.S.I., I.C.S., President.

The Delegates.

Before the proceedings began, Colonel King, by permission of the President, made the following statement:—

With reference to yesterday's proceedings I would ask that the following facts affecting procedure be placed on record:—

The Chairman of the day ruled that discussion should be limited to measures against mosquitoes. Captain Christophers had read a paper, at the conclusion of which, whilst referring to drainage, he formally advised the employment of quinine. In my attempt to show that this conclusion of his otherwise admirable investigation was premature, I was interrupted by the Chairman (doubtless legitimately) on the ground of time. I subsequently desired to move a resolution to the effect that "surface and subsoil drainage are valuable anti-malarial measures." In reply to protests by the Chairman, I explained that this resolution was intentionally of a general nature, and was not limited by a definition of localities such as in the case of a previous resolution, which advised the employment of surface drainage in municipalities. I respectfully hold that my proposed resolution was appropriate, in that drainage is a measure of a radical and permanent nature directed against mosquitoes and therefore against malaria, that it had distinct reference to the papers discussed and to the Chairman's ruling, and that I was within my rights in endeavouring to secure a definite expression of opinion by the Conference on this most important branch of radical anti-malarial measures, desirable especially in the great centres of malaria as contrasted with palliative measures which, for financial reasons, are necessary elsewhere. The Chairman however refused to put my proposed resolution to the Conference.

The President said that on the previous day as Colonel King had exceeded considerably the time limit allowed to each speaker he had suggested to him that his remarks should be brought to a close. In regard to Colonel King's proposed resolution it appeared to him that the first part was covered by the resolution upon drainage measures that had already been passed, and he ruled it out of order, but offered to put the second part. Colonel King, however, declined to accept this offer and withdrew his resolution.

Colonel Braide proposed that in order to allow more time for discussion the remaining papers should be taken as read.

The President put the proposal to the Conference and it was agreed that with the exception of Major Donovan's paper, which had only just been received, the papers for the day should be taken as read.

The following was the first paper on the programme:—

A summary of Anti-Malarial measures in the Punjab compiled by Captain C. A. Gill, I.M.S., under the direction of the Inspector-General of Civil Hospitals, Punjab.

The devastating effects produced by malaria on the people of the province have long been a source of anxiety to the local Government and its medical advisers.

Amidst much that was ambiguous, two points have always been clearly recognised—first, that malaria was extremely prevalent in the Punjab and, secondly, that it was especially common in low marshy regions and along the banks of those rivers (and their tributaries) which form so prominent a feature of the provincial geography. As long ago as the early eighties the deleterious effect produced by inundations from rivers and canals on the prison population was so striking as to form the subject of a representation to Government.

At this time, however, the etiology and epidemiology of the disease were largely wrapped in obscurity; for it may be recalled that it was not until 1880 that Laveran made the epoch-making discovery of the specific cause of the disease, and the agency of the mosquito in its transmission was not discovered by Ronald Ross until some 18 years later. Medical administrative measures must always wait on science, and it was therefore not to be expected that much could be attempted until our knowledge on these two cardinal points became more precise. The history of anti-malarial measures in the Punjab may therefore be divided into three periods, which follow, as they should, in measured tread the results of scientific research.

The first period may be said to end with the year 1900, the second to comprise the years 1900-1907, and the third—by far the most important—commenced in 1908 and deals with the state of affairs as we find it at the present time.

In regard to the period anterior to the year 1900, there is not a great deal to be said: the measures that were adopted were neither extensive nor important; quinine was used both as a prophylactic and curative, but the extent to which it was administered depended more on the initiative of individual medical officers rather than organised effort. Thus it is of interest to note that the prophylactic use of quinine was tried on a small scale in the Delhi jail as early as 1887. Accurate knowledge of the extent and severity of the disease amongst the civil population was difficult to obtain, and it is therefore not surprising that it was in the jails, where efficient control and supervision could alone be exercised, that its terrible effect came first prominently to notice. The jail mortality was at this time high, and it was recognised and represented by the medical officers in charge that malarial fevers, though not actually responsible, were the main predisposing cause, and that if the disease could be mitigated or eliminated, a great reduction in the jail mortality would immediately ensue.

Actuated by these motives, it was decided in the year 1893 to carry out systematically the prophylactic use of quinine in all the jails of the province. This scheme, which constitutes the first systematic effort to deal with malaria in the Punjab, met at first with many difficulties and some opposition, but it has been steadily persevered with and improved, until at the present time the jail population possess a degree of immunity from malaria and a general healthiness in marked contrast to that of the surrounding population. Thus in 1890, before quinine prophylaxis was commenced, there were 11,934 admissions from malaria compared with 1,997 in 1908. Although the sanitary condition of the jails has been materially improved, nevertheless, there cannot be room for reasonable doubt that the great reduction in the sickness and mortality in recent years is largely ascribable to the use of quinine.

The first attempt to deal with the civil population was in 1889, when the then Lieutenant-Governor, in consequence of a letter from the Reverend Mr. Carlton, a missionary, appointed a committee to enquire into the feasibility of reducing the extensive sickness and mortality in certain districts in the southern portion of the province. As a result of the deliberations of this Committee it was decided to distribute quinine *gratis* in six districts of the Delhi division, and that District Boards, with the financial assistance of Government, should be encouraged to undertake such drainage schemes as were feasible. Accordingly, in 1890, free distribution of quinine in this area was undertaken, zaildars and village headmen being the chief distributing agency employed. In 1893 the scheme was improved and extended to other parts of the province, the distribution being carried out by district boards as well as numerous official and non-official persons. In 1892 the “pice packet”

system of quinine distribution through the agency of the Post Office had been introduced in Bengal, and in 1894, on the proposal of the Inspector-General of Civil Hospitals, it was decided to extend this system to the Punjab. Accordingly, in 1895, with the sanction and co-operation of the Postal Department, this method of distribution was inaugurated on an experimental scale in the Delhi division. It was, however, a failure, chiefly owing to the fact that free distribution was being carried out at the same time, and it was consequently abandoned in 1897. This is worthy of note as the danger of allowing the two systems to exist side by side is not without its lesson at the present time. In 1899 another and more successful attempt was made to introduce it into the Lahore and Delhi divisions, free distribution in these areas (except at dispensaries) being meanwhile discontinued.

The great advances made in our knowledge of the epidemiology of malaria in the closing years of the 19th century had the effect of causing further efforts being made to deal with the disease. These included not only quinine distribution, but also the carrying out in urban areas of simple measures of sanitary reform with special reference to mosquito extirpation. In 1902 the sale of quinine by Post Office agency was extended throughout the province, and in this and the following years efforts were made to popularise the measure and to spread knowledge amongst the people in regard to the self-treatment of the disease.

It must, however, be admitted that, judging from the sales that took place, the demand for quinine was at no time great, and the financial condition of local bodies, even with subsidies from provincial sources, was such as to preclude the inauguration of major sanitary works on a large scale. In 1904, however, 17 such schemes were approved by the sanitary engineer on the recommendation of the Sanitary Board, to which the local Government contributed a grant-in-aid of Rs. 19,148. In 1905, 15 sanitary works were inaugurated, the grant-in-aid from Government being Rs. 29,961. In 1906 Government made grants-in-aid amounting to Rs. 30,000 for 23 undertakings. In 1907, 11 schemes were sanctioned, the Government grant-in-aid amounting to Rs. 10,800; in 1908 Government contributed Rs. 69,078, and in the present year the grants have been increased to treble this amount. In 1907 quinine prophylaxis during the months of August, September, October and November was introduced into the police force and carried out for the first time.

Such was the state of affairs on January 1st, 1908, which marks the commencement of the third and most important period in the history of anti-malarial measures in this province. On May 11th, 1908, the Inspector-General, not being satisfied with the progress made in combating the disease, addressed Government on the subject, and formulated proposals for popularising and extending anti-malarial measures in general and quinine distribution in particular. These suggestions were received with marked approval by the Lieutenant-Governor, who, being greatly impressed with the importance of the subject, desired that even greater efforts should be made to deal with the formidable evil. The result was that the following measures were adopted:—First, in order to increase the interest of postmasters in the sale of quinine, and to stimulate them to greater activity, the commission allowed on the sale of each packet of the drug was increased from 2 to 4 annas; secondly, the basis of distribution was greatly widened by enlisting schoolmasters, native druggists, holders of licences from the Excise and Stamp departments, as agents for its sale. Another important new departure was the establishment of a central agency to control the distribution of the drug. This was taken out of the hands of the jail department, to whom it had been entrusted in 1902, and placed under the direct control of the Inspector General of Civil Hospitals, who was supplied with a special staff for the purpose.

The need for these measures was only too well exemplified in the following autumn, when the Punjab was visited by an epidemic of almost unprecedented severity. Its extent can be to some extent appreciated from the fact that the mortality from malaria was in round numbers 700,000, compared with 400,000 in the preceding year, thus giving a death-rate of 34·66 *per* 1,000 instead of 19, which is roughly the average of the previous four years.

But even this enormous mortality affords but a feeble indication of the amount of sickness, with its concomitants of misery and poverty, that prevailed. It has been estimated that in some districts 90 *per cent.* of the population were at one time or another afflicted with the disease during this period.

Labour was seriously disorganised and the price of foodstuffs throughout the province ruled high. The far-reaching effects of the epidemic are well exemplified

in the case of the North-Western Railway, where, owing to the fact that many of the staff were incapacitated, the train service had frequently to be suspended, to the great financial loss not only of the department, but also of commercial and agricultural interests generally.

To meet the emergency extraordinary measures were necessary and were promptly adopted. Quinine was distributed free of charge on a large scale; over 6,000 pounds were disposed of by the central agency alone. The plague and vaccination staff were requisitioned to distribute the drug and afford medical relief to the people. Four itinerating hospitals in charge of hospital assistants were despatched into the most severely infected areas, where they administered relief to 17,136 persons. In addition to these four others were organised by the district board in the Lahore district. Finally, local bodies were encouraged to buy large quantities of quinine on the understanding, which has since been realised, that Government would indemnify them of all expenditure incurred in this manner.

After the epidemic efforts were redoubled and the whole question was considered in the light of recent experience. The channels of distribution were defined and endeavours were made, while preventing overlapping, to elaborate a network all over the province whereby quinine could be easily and cheaply placed within the reach of every person wishing to obtain it. The scheme is not yet in all particulars complete; but the great measure of success which has so far been attained is largely due to the great interest and enthusiasm of the Lieutenant-Governor, who has practically caused the whole machinery of Government to be brought into play to give effect to this policy.

The following are the most important measures that at present have been adopted:—

- (1) Two "Eureka" tablet-making machines capable of turning out 25,000 tablets a day have been purchased and are now in use in the Lahore Central Jail.
- (2) The question of stocks and storage has been satisfactorily settled and a large reserve of quinine has been provided to meet emergencies.
- (3) To bring the drug within reach of the rural population the following procedure has been laid down:—
 - (a) *Distribution on payment*.—This is carried out by the central agency alone. The drug is supplied either in tablet or powder form to postmasters, schoolmasters, patwaris, native druggists, holders of licences from the Excise and Stamp Departments, and any other respectable persons recommended for this work.
 - (b) *Free distribution*.—This is carried out by the local agency. It is the duty of district boards and municipalities to supply the drug to the dispensaries under their control and to zaildars and others for distribution to those who are unable to purchase it for themselves.
- (4) Efforts have been made to spread knowledge in regard to malaria by the issue of a pamphlet in Urdu and Gurmukhi entitled "Malaria and how to escape from it" to all zaildars and others in the province. Arrangements are being made to paste a leaflet on the cover of books used in schools giving a few simple facts about malaria, and, lastly, the plague staff have been ordered to utilise every opportunity of spreading knowledge about malaria amongst the rural population.
- (5) The formation of 30 itinerant hospitals to be kept as a reserve to meet emergencies have been sanctioned, and they are in process of formation.
- (6) To meet the case of officials and Government servants, the following measures are in operation—
 - (i) Quinine prophylaxis, as already stated, is carried out during the fever season in the jails and in the police force throughout the province.
 - (ii) Government servants drawing less than Rs. 10 a month are provided with free issue of quinine, which they are required to take once a week during the period from August 15th to November 15th each year. Persons who refuse to take the drug without adequate reason may be

put on general instead of casual leave at the discretion of the head of their department, if they require leave of absence on account of malaria.

(iii) A free issue during the same period is also given to the establishment of settlement officers.

- (7) For some years quinine has been distributed more or less widely amongst employes of the North-Western Railway, a special stock of the drug belonging to the railway being kept at Lahore for the purpose. During the current year this has been systematised, and steps have been taken to carry out adequate quinine prophylaxis for all railway employes in the province during the fever season.

Another measure which it is intended to adopt shortly is the reduction of the price of the packet of quinine (containing 102 powders) from 1-5-6 to 15 annas. This measure, which has only recently become possible owing to the market price of the drug having fallen, will, it is hoped, tend to considerably increase its sale. It is also intended to supply the drug in tablet form instead of the powders now in use. This arrangement has been found to be exceedingly satisfactory, as not only is the drug much appreciated in this form by the people, but it ensures accuracy of dosage and prevents adulteration. It is expected that it will be possible to issue the drug in 5-grain tablets at the cost of one pice each, or three tablets for one pice.

To further popularise the sale of quinine and spread knowledge in regard to malaria, it is intended at the forthcoming exhibition to be held in Lahore to display samples of cinchona bark and to have quinine on sale in both tablet and powder form. It is also proposed to show the tablets in process of manufacture, and lastly, but by no means least, it has been decided to erect two houses, one built in accordance with the plan commonly adopted in villages and the other modified in order to conform to the elementary principles of hygiene.

Much has been said in regard to quinine. Its importance indeed cannot be overrated. It may therefore be not out of place to mention that as a result of experience the following principles have been adopted in regard to it :—

- (1) Quinine, except in the case of emergencies or to the very poor must not be supplied free of cost, for it has been found most desirable on many grounds that a small, if merely nominal, price should be charged for it;
- (2) The sale of quinine by all agencies should be at a uniform price;
- (3) When quinine prophylaxis is carried out, it is desirable that the procedure should be as simple as possible with due regard to efficiency, and it is therefore recommended that the drug should be exhibited in full dose on one day each week.

Conclusion.

While laying the greatest possible stress on quinine, the medical advisers of Government have been careful to point out that other measures must not be neglected. Quinine is but a temporary measure, and it is not by the use of this drug *alone*, even if it were possible to administer to the whole population, that malaria will ever be banished from this province.

In addition to measures of sanitary reform and drainage schemes aiming at mosquito extirpation there is an urgent necessity for the gradual introduction and enforcement in towns and villages of regulations calculated to promote a higher standard of living amongst the people. It is impossible to overrate the value, in the lessening of disease generally, of the observance of a few elementary rules of domestic hygiene and personal cleanliness. In the crusade that has been inaugurated in the Punjab these measures have therefore been considered, but the manifold and manifest difficulties which they present militate against their hasty adoption, and for this reason nothing has so far been done, and it has therefore been necessary to lay great emphasis on the value of such measures as quinine which are capable of immediate adoption. But even the latter measure, it must be remembered, is by no means free from difficulty. In the past the high price of the drug and small supply available would have prevented its use in large quantity even if there had been any demand for it. This state of things has, as regards the Punjab, happily disappeared. The price of the drug has decreased from Rs. 15 per pound in 1905 to Rs. 7-14-0 per pound at the present time. The provincial Government

and local bodies are free to obtain it in the cheapest market, and there is thus a practically unlimited supply now available.

The only remaining difficulties rest with the people. There is still a good deal of prejudice against the use of the drug, which, though not insuperable, will require a good deal of time and patience to overcome.

Quinine is unfortunately considered a "hot" medicine, and therefore unsuited to a disease like malaria, which is attended with high fever. There is also an idea prevalent amongst even educated Indians that its exhibition must be accompanied by large quantities of milk.

These difficulties can only be met by education and experience, and in this connexion it may be hoped that the Malaria Conference will issue some authoritative statement calculated to remove apprehensions of this nature from, at any rate, the minds of all educated persons.

Finally, it has been the desire of Government, in giving effect to these measures for promoting the health and prosperity of the people, to avoid either hasty action or undue display of anxiety lest unwittingly the easily excited suspicions of the people should be aroused in regard to their beneficent intentions.

The following was the next paper :—

Problems relating to the use of Quinine, by Major S. P. James, I.M.S.

Before commencing an attempt upon a considerable scale to combat malaria in India by the widespread employment of quinine, it is obviously advisable to make a thorough study of many problems connected with the drug, and therefore I have thought it would be useful to summarize briefly our knowledge in regard to some of those problems and to indicate some lines of investigation that should be followed in this country. Very little work upon quinine has been done in India, and although in our hospitals generally the results of using the drug according to the routine methods described in text-books are good, it often happens that the time taken for the cure of malarial patients is unduly long, the amount of quinine used is unnecessarily great, and a number of cases occur in which the drug appears to be quite inefficacious. Many failures to prevent attacks of malaria by the use of quinine, especially among British soldiers, are also reported, and there is no doubt that in the near future such reports will become increasingly numerous. Failures of this nature would be very detrimental to the success of an attempt to popularize the use of quinine in India, and it is therefore necessary that we should by careful research ascertain the causes of failure and guard against them. It can be laid down at once that, since quinine is known to be fatal to the malaria parasite, the cause of failure in its use is due not to the drug but to a want of knowledge regarding the correct way to employ it, and it would therefore be of great advantage if as a result of a well-arranged plan of investigation we could obtain such knowledge as would enable us to formulate improved rules in regard to (1) the doses of quinine that should be employed in order to cure the disease in the quickest time and with the least inconvenience to the patient; (2) the proper times in relation to the access of fever at which the doses should be given; (3) the best salt of the alkaloid to employ and the best mode in which to administer it; (4) the best plan of using the drug for prevention.

Many attempts to answer these questions have been made in Europe, but the results obtained by different observers are very contradictory, and we have no guarantee that what applies to European patients will hold good for natives of India—indeed, knowing as we do from Captain McCay's researches that the composition of the blood of non-flesh eating natives of India differs considerably from that of the blood of flesh eating Europeans, and that in all probability the processes of absorption, metabolism and elimination also differ considerably in the two classes of people, it is essential that we should not be content to rely upon European experience but should study the matter thoroughly for ourselves.

The all-important object of such a study would be to obtain knowledge that would enable us to draw up improved rules for treatment and prevention, and in regard to this the first matter upon which we require further and more definite information is the action of quinine upon healthy natives. Before we can allow ourselves a free hand in distributing the drug for indiscriminate use without

medical supervision we should be satisfied that the results of such use cannot be otherwise than beneficial. Our knowledge of this subject is too slight to enable it to be discussed adequately. We are aware that the deficiency of hæmoglobin in the red blood corpuscles of natives of India renders their oxygen carrying power less than that of the red blood corpuscles of Europeans and that large doses of quinine may be deleterious, as Binz has shown, by binding the oxygen more firmly to the hæmoglobin thus further inhibiting the oxygenating power of the blood. It has been said also that the administration of certain salts of quinine tends to lessen the power which the red blood corpuscles have of resisting hæmolysis. Captain MacGilchrist has lately made some interesting observations on this subject. The effect of large doses of quinine upon the leucocytes has also to be investigated more thoroughly, but so far as we know at present the administration of such doses does not lessen their phagocytic activity or mobility. On the whole I think that, although there is no definite evidence that large doses of quinine are harmful and much evidence that such doses are harmless, it will be agreed generally that for both hygienic and economic reasons a prime object of investigation should be to ascertain the *minimum* doses that are effective in treatment and prevention respectively.

In the second place we require further study of the action of quinine upon different stages of the malaria parasite. If quinine were immediately fatal to all forms and stages of the parasite the treatment of cases would be exceedingly simple, and deaths of malarial patients who had received quinine would be almost unknown. Unfortunately the matter is very complex, the success of the drug depending upon a number of factors about which we know little or nothing at present. The time of administration is all important because we know that the drug is immediately fatal to only one stage of the parasite, namely, to that stage which follows sporulation. Upon all other stages it is either entirely inoperative (*e.g.*, upon the sexual forms) or acts in a manner that may make it entirely wrong to give the drug at a time when it will act upon such stages. For example, it is the experience of nearly all observers that quinine given when the blood contains only endoglobular parasites often prolongs the paroxysms of fever and may convert a simple definitely intermittent fever into one that is almost continuous. Also it is now nearly 20 years since Marchiafava and Bignami pointed out that if large doses of quinine are given when the blood contains only pigmented parasites in process of development, the result may be the appearance of numerous sexual forms of the parasite instead of the usual asexual forms. This phenomenon of the abundant formation of gametes after large doses of quinine has been again observed and written about quite recently in Italy, and I think it quite possible that in this country the common observation of numerous crescents in the blood of European soldiers who are being treated with large doses of quinine is also an example of it. In Mian Mir last year crescents were exceedingly numerous in the blood of European soldiers who were receiving considerable amounts of quinine once or twice a week, and in this respect the examination of their blood yielded results which were very different from those obtained in the examination of the blood of untreated natives. In the blood of the latter it was rare to find crescents. Relapses of fever which almost certainly were brought about by the development of the female crescents parthenogenetically were also exceedingly frequent among the European troops, and it appeared doubtful whether the large doses of quinine at intervals of a week had any effect in preventing these relapses. It is possible therefore that by administering large doses of quinine more or less in a haphazard manner we may not only be placing the patient in such a condition that he is very liable to relapses, but may be increasing enormously the sources from which anopheles mosquitoes become infected. This possibility is worthy of serious consideration and investigation. Another problem which requires to be worked out thoroughly is the action of quinine upon the flagellated parasite. We know that the drug is inoperative upon crescents in the human body—that is upon crescents that are surrounded by the protecting envelope of the red blood corpuscle—but we do not know what might happen to a crescent that was subjected to the action of quinine after it had reached the stomach of the mosquito—that is after it had escaped from its protecting envelope and had become a flagellated parasite. One can scarcely imagine that the microgametes (flagellæ) could survive the action of even a minute quantity of quinine and if this were the case it might be possible so to arrange our treatment of a patient whose blood contained gametes that he would be non-infective. Anyone who has observed how numerous are the

gamete forms in the blood of some European soldiers will realise the importance of this matter. I am aware that the formation of zygotes in the stomach of a mosquito that has sucked blood from a patient who was undergoing quinine treatment has been reported, but the interpretation to be placed upon this result depends entirely upon whether quinine was or was not present actually *in the blood* of the patient at the time he was bitten by the mosquito. I shall note later that although quinine may be present in the body for a considerable period, its length of stay in the peripheral circulation is probably exceedingly short, and that in all probability the only way in which we can keep some of the drug in the circulation is by giving doses at frequent intervals. There are other problems of importance in this connexion, but a consideration of them would lead us too far astray from our present purpose. On the whole we see that the problem of the action of quinine upon the different stages of the malaria parasite urgently requires further study, and that in the present state of ignorance it is perhaps unwise to attempt to attack any stage of the parasite except that very vulnerable stage which immediately follows sporulation. It is reasonable to suppose that a very small amount of quinine suffices to kill that stage and it may well happen that having discovered the minimum effective dose for that purpose and the exact time in relation to the access of fever at which it should be given, it might be advisable to change entirely our present routine methods of treatment.

But even in the attack upon the vulnerable stage we have still much to learn before we can consider ourselves upon sure ground. We must know first as regards the parasite (1) in what parts of the organism does sporulation occur and does it occur in any positions which cannot easily be reached by quinine? (2) how long before the beginning of fever does sporulation commence? (3) how long does it last? and, second, as regards quinine, (1) do we require the drug to be present in the peripheral blood or in the internal organs or in both? (2) how soon after administration by different methods will it be present in the parts of the system where it is required? (3) when will its action in these situations be greatest? (4) how long will it remain there? (5) in regard to these points what are the differences according as we administer large or small doses and according as we administer the amount in a single or in divided doses? (6) what is the smallest dose that will be sufficient to kill all the young parasites of a given generation? (7) what are the differences in the use of the drug for adults and for children? (8) what are the differences according as we administer the drug by different methods? and (9) what is the relative value of different salts of the alkaloid and of different ways of dispensing it?

Very few, if any, of these questions can be answered without further investigation of the physiological chemistry relating to the absorption, metabolism and elimination of quinine by the human body. In Europe a considerable number of experimental observations upon some of the subjects have been made but it is very necessary that they should be repeated upon natives of India and extended in many ways. The following are among the more important results obtained in Europe:—(1) Quinine when administered by the mouth is absorbed chiefly in the stomach and small intestine. Absorption is very rapid and very complete and observers generally are agreed that preparations of the drug which are insoluble in water are absorbed as completely, if not quite as rapidly, as the most soluble salts. By far the greatest proportion of the quinine administered is absorbed during the first six hours after administration, but the process is less rapid if the drug is given on a full stomach. (2) From the alimentary canal the drug passes into the blood, but on account of the great difficulty of detecting quinine in the blood, we know almost nothing about the duration of its stay or about the way it is carried in that fluid. In an endeavour to detect quinine in the blood Giemsa and Schaumann made a number of experiments upon animals and were able only once to prove its presence in the blood of a dog to which lethal doses had been administered. In this instance the quinine was found in the blood serum only—the red corpuscles being proved to contain none. These observers concluded that from the alimentary canal the blood can take up only very small quantities of quinine at a time, and that what is taken up is either quickly destroyed or quickly deposited in the organs. They consider that this is the only hypothesis on which we can explain the fact that although a considerable amount of quinine is present in the urine very shortly after administration only very small traces of the drug can be found at any given moment in the blood. If their results in regard to the quick disappearance of quinine from the blood

are correct, they indicate the paramount importance of ascertaining the exact time at which the drug should be administered in order to secure its presence in the blood during sporulation. (3) Whatever may be the quantity of quinine that is present at any given moment in the blood, and whatever may be the length of its stay there, it is fairly certain that a large proportion of what is administered by the mouth quickly becomes deposited in various organs, chiefly the liver, gall bladder, kidneys, suprarenal bodies, brain and spleen; and that in these organs, but chiefly in the liver, the quinine molecule is split up and the drug destroyed. According to Mariani the amount of quinine thus used up in the body is about 33 per cent. of the amount administered and according to Giemsa and Schaumann about 66 to 75 per cent. I am not prepared to say whether the quinine that is thus stored up and metabolised in the organs takes a part in the destruction of parasites or not. Most authors consider that the only useful portion of a dose of the drug is that which, having escaped destruction in the organs, passes through the circulatory system and is ultimately eliminated in the urine; others consider that the amount of quinine that the blood can contain is so small and the length of its stay in that fluid is so short, that we must regard the whole action of destruction of parasites as taking place in the organs, in which case the quinine deposited in those viscera would be all important. It is obvious, of course, that a considerable portion of the quinine that is absorbed from the alimentary canal and passes by the portal vein to the liver, where it is destroyed, never gets into the general circulation, and according to Plehn the advantage of giving the drug subcutaneously lies in the fact that when so given it has to circulate for an appreciable time before getting into the liver, where it is destroyed. (4) The quinine that is not destroyed in the body is eliminated in an unchanged condition in the urine, the amount so eliminated being usually about 25 to 33 per cent. of the amount administered. Hardly any is eliminated in the fæces and none in the sweat. We cannot regard the amount eliminated as a measure of the amount that has been absorbed nor can we consider the period of elimination as an indication of the period during which the drug is present in the blood. But the rapidity of absorption and elimination is indicated by the fact that Lewin found traces of quinine in the urine from 13 to 17 minutes after the administration of a soluble salt of the alkaloid, and Giemsa and Schaumann found the drug 25 to 30 minutes after administering the pure alkaloid which is exceedingly insoluble. Elimination is greatest during the first six hours after administration, and although faint traces can be detected for three days it may for practical purposes be considered as being concluded in 24 hours. This is also the period during which elimination lasts when the drug is given subcutaneously. The percentage of quinine eliminated differs according as the drug is administered in a single dose or in small doses frequently repeated, and it differs with the administration of soluble or insoluble salts, but the correct way in which these results should be interpreted is by no means certain.

So far as anything useful can be obtained from these results, I think the most important indication is afforded by the statements relating to the quick absorption of quinine and its quick disappearance from the blood. These show that the time of administration is all-important and that our efforts should be directed to securing a more lasting action of the drug rather than to securing the administration of larger doses than are at present given. Clinically it has been shown that the administration of the drug in small doses frequently repeated is more efficacious than administration in a single large dose, and it would seem that until we have fuller and more accurate information, the repetition of doses at short intervals is the only plan by which we can ensure that the drug will be in the blood whenever forms resulting from sporulation appear and will continue to be present throughout the whole period during which sporulation lasts. The method is an old one, but under the name of Nocht's fractional method of treatment it has been recently reintroduced and employed with excellent results by a number of observers. It should certainly be adopted for extensive trial in this country. In regard to the so-called "after treatment" of patients it may be noted that in view of the possibility that the formation of gametes may be increased by administering comparatively large doses of quinine once or twice a week, Celli considers that after the actual attack of fever is over we should reduce greatly the daily doses of quinine and should not attempt the almost impossible task of quickly eradicating the parasites by the continued administration of large doses. For the prevention of the disease it must be recognised that it is all-important to kill the injected

sporozoites before they have had time to get into the fortress of the red blood corpuscles. If once we allow the parasites to proceed unchecked through several asexual generations, difficulties arise which are not easily overcome. A very small dose of quinine suffices to kill the sporozoites, but it is obvious that in this matter, as in treatment, the time of administration requires chief attention. A common prophylactic method is to take a few grains of quinine every morning, but in view of the quick absorption of the drug and its rapid disappearance from the peripheral blood it may well be that a dose taken, say at eight in the morning, would be useless by 12 o'clock the same night. If this is the case it is evident that since protection is required only during the night we should take the prophylactic dose in the evening. Attention to such a simple matter as this might make all the difference between success and failure.

We see, then, that from the data provided by the experimental work summarized here we arrive at two very important results, namely, (1) the best *routine* method of treating malaria is to administer doses of quinine at frequent intervals, and (2) the best method of using quinine for the prevention of malaria is to take a small dose every evening. But while I submit that in the present state of knowledge these principles should be followed in any scheme for extending the use of quinine in India, I do not bring them forward as a final solution of the problem. I trust also that no one will consider that I believe good results cannot be attained by other plans. For example it is impossible to doubt that in the Punjab jails last year the administration of 15 grains of quinine once a week was an exceedingly effective method, and among both prisoners and soldiers other almost equally striking successes by that method have been recorded. I take leave also to guard myself by saying that although the experimental work here recorded enables us to explain very simply and easily the causes of most of the reported failures to diminish malaria by the use of quinine, we have at present in India no observations by which the accuracy of that experimental work can be verified. This being the case I need hardly say that I have recounted the work in order to show that even upon the subject of quinine, about which there ought to be a mass of accurate information, there is in reality extremely little, and that even upon this subject it is urgent to initiate further investigation. One desires also to combat the absurd view held by some critics in England to the effect that all the really useful knowledge about malaria and the methods of preventing it has been discovered, and that instead of occupying ourselves with trying to find out the value of those methods and the correct way of applying them, we ought long ago to have begun to carry them out blindly, here, there, and everywhere, regardless not only of expense, but of every other consideration that might quite naturally occur to a rational person.

The following paper was read:—

The most useful salt of Quinine for general distribution in Malarial tracts by Major C. Donovan, I.M.S.

I propose to read a short paper on this subject, embodying my experience of the use of quinine in powder, and not in solution, in the treatment of malaria.

I shall take up the subject under the following heads:—

1. Quinine sulphate in powder, in doses of 7 to 10 grains, and taken without solution in dilute acids, is generally useless. The solubility of this salt is 1 in 800 of water.
2. Quinine hydrochloride, a much more soluble salt, 1 in 30 of water, does not give, in doses of 5 to 10 grains in powder, universally satisfactory results. On the whole it is far preferable to the very insoluble sulphate.
3. Would the production of the hydrochloride be feasible in the Government factories, and, if so, would the cost of its preparation, in comparison with that of the sulphate, be prohibitive for general distribution among the populace?
4. Results of dosage of the very soluble salt, acid hydrochloride, soluble 1 in 1 of water, given in powder are very much more satisfactory than the preceding two salts of the alkaloid. But it is feared the cost of preparation would be prohibitive.
5. Summary and precautions on the indiscriminate use of quinine in general.

Before taking up the separate headings, I may say that the results I am about to formulate have been derived from observations made at the General Hospital, Madras, since the year 1903, a period of five years excluding a year and a half I was absent on leave. The total number of cases of malaria that came under attention aggregated 429. The number appears small, but I may mention that all these cases were most carefully studied during their stay in hospital. I do not include in this category numerous other cases of paludism that were observed by me in and out of hospital during the last 18½ years. In 1903 I started demonstrating to my students the futility of giving quinine in powder. Again, it is not to be presumed that I have dosed my 400 and odd hospital patients with quinine in powder; a very small quota have been subjected to this mode of treatment, roughly speaking about 50 in all.

1. Sulphate of quinine taken in powder in the usual dose of 7 grains as supplied by the Post Offices I found useless. I have on several occasions, when patients were suffering from benign malaria, and with their full consent, given an object lesson to my students of the uselessness of giving quinine undissolved in dilute acids. The results were in all cases checked by microscopical examinations of the blood.

2. Hydrochloride of quinine in powder in doses of 5 to 10 grains gave better results, as was to be expected; but here again disappointment was occasionally met with.

3. The hydrochloride, as it gives better results than the sulphate, would be the salt to distribute among the general population of malarious areas, especially in the form of tabloids containing 10 grains of the salt and 1 grain of citric acid. I would ask for information regarding the feasibility of the production of the hydrochloride in India.

4. The results with the very soluble salt, the acid hydrochloride, are doubtless good, though occasional cases resistant to its powerful action have been observed. The cost of this drug places it, I fear, beyond the reach of general use.

5. To summarise I may say that I have very little faith in the use of quinine powder given in ordinary doses. On the other hand, there is no gainsaying the results obtained by the exhibition of the different salts in solution in dilute mineral acids. I usually employ for a dose 30 grains of the sulphate, or 20 grains of the hydrochloride or 10 grains of the acid hydrochloride, dissolved in a dram of dilute mineral acid, sulphuric or hydrochloric, in about 2 to 3 ounces of water.

I always administer quinine in solution by mouth and rarely am I forced to resort to the hypodermic method. My hospital and general practice have taught me to place no reliance on intra-muscular injection of quinine, hypodermic or subcutaneous injection is nearly on a par with giving the alkaloid in powder by the mouth.

Intra-muscular injections do act, but the action is decidedly slow. In a case of chronic malaria that had been injected by quinine in the buttock and back twice a week for nearly a year, I have removed the unabsorbed quinine, loosely speaking, in handfuls, from the ulcers caused by its presence in the tissues.

I finish this very brief paper with a word of warning as to the indiscriminate use of quinine for long periods; it is a potent drug for good and evil. It is not to be forgotten that permanent damage has resulted by the misuse of the alkaloid for a long time, for instance, permanent deafness, defects of vision, &c. And last, but not least, though happily on rare occasions, the occurrence of tetanus resulting from hypodermic injection of quinine must not be overlooked. I hope my paper will result in a useful discussion on the merits and demerits of giving quinine in powder for the use of the general population of the malarious tracts in India.

The following discussion ensued:—

Colonel Lukis said that he had read with great interest Major James's valuable and instructive paper. There was no doubt whatever that quinine was fatal to the malaria parasite, but he proposed that the Conference should pass a resolution to the effect that careful experiment and investigation was necessary with the object of formulating definite rules:—

- (1) As to the proper dosage of quinine;
- (2) Its time for administration;
- (3) The best salt of quinine and the most suitable method of administration;
- (4) The best method of using it for prophylactic purposes;
- (5) As regards the class of cases in which the use of quinine was inadmissible.

Such investigation, if carried out by properly trained observers, he regarded as being at least as important as the one that had already been decided upon with reference to the mapping out of fulminant malaria areas. As regards (5) the reasons for the proposal were that every practical physician was fully aware that there were many cases of malarial origin in which quinine did more harm than good and the stoppage of the quinine led to a disappearance of the fever. Major James had alluded to this point in his paper. Further investigation was necessary. There was also the very important question of the relationship between quinine and black-water fever.

He wished to offer a few remarks with regard to the practical difficulties regarding quinine prophylaxis, and in so doing he would divide the subject into two heads—

(1) Quinine prophylaxis as it concerned people under discipline, soldiers, prisoners and the like; and

(2) Quinine prophylaxis as it concerned the general public. In the first case they were dealing with bodies of men who were bound to obey orders and they did not encounter the difficulties which beset the administration of an unpalatable drug to children. Therefore there was only one point in this connection on which he desired to lay stress. This was one to which Major Donovan had drawn attention; when quinine was administered as a prophylactic to soldiers or prisoners the drug should be given in solution. Unless this were done it would not be possible to get any reliable deductions from the results; for three very good reasons:—

(1) Most quinine tabloids, unless they are perfectly fresh, become hard and are thus apt to pass through the bowels unchanged like pebbles;

(2) Even if the tabloid be a soluble one we can never be quite sure that it would undergo solution in the stomach, if taken when the stomach was full of food or if the patient be suffering from dyspepsia. The quinine would then pass unchanged into the intestines and the result would be delay in its absorption;

(3) If the drug were given in solution, one could be perfectly sure that it would be swallowed, whereas a tabloid could be concealed and be then disposed of, which was not an infrequent occurrence.

The next was the important question of prophylaxis as it affected the general population. In this case one had to deal with people who were free agents and need not take quinine unless they wished to do so. They were met with four very serious difficulties:—

(1) A very large number of Indian patients are averse to the use of English medicines, and they have a strong prejudice against quinine, which they consider has heating properties, and is therefore unsuitable for the treatment of febrile diseases.

(2) An Indian regards a medicine as something to be taken only when ill. He has no knowledge of prophylaxis, and it is often impossible to persuade him to take medicine for that purpose.

(3) It is extremely difficult to administer quinine to children, who are the chief disseminators of malaria; this difficulty is particularly great when dealing with Indian children.

(4) In this form of prophylaxis it is not possible to administer quinine in solution; it has to be distributed in solid form, and one could not be sure of getting the full value of the drug. If the quinine prophylaxis, as it concerned the general population, was to be successful in any given area, four things would have to be accomplished:—

(1) It is necessary to overcome the prejudices of the public against English medicines, especially quinine.

(2) They should be educated in the belief that prevention is better than cure.

(3) Some palatable form of quinine for administration to children would have to be devised.

(4) It must be given so as to be quickly absorbed by the stomach. Otherwise there would be failure.

In carrying out prophylactic measures with a view of preventing the spread of the epidemic, two objects had to be kept in view:—

(1) To protect the individual;

(2) To prevent him from becoming a source of infection to other persons.

It would be admitted that if in a given village one only succeeded in protecting a small proportion of the inhabitants, this would certainly be an advantage to them, but it would have little or no effect in preventing that village from becoming a fulminant area. This was clearly explained in the paper read by Captain Christophers. For these reasons, whilst agreeing that quinine prophylaxis properly carried

out, was one of the most valuable weapons in the fight against malaria and whilst admitting that in rural areas it was probably the only weapon at the disposal of Government he felt bound to express his opinion that if they were to place sole reliance on this measure in Indian villages they would be bound to be disappointed. Quinine prophylaxis should go hand in hand with general sanitation and with the destruction of anopheles breeding grounds, whenever this could be accomplished at reasonable expense, and with all possible methods and efforts to improve the physical welfare of the population. He was in favour of no large drainage schemes; he agreed in the views expressed by Major Rogers, and by Captain Christophers, views which are shared also by Major Ross, who in his recent address at Bombay said very clearly that great care must be taken in the selection of large undertakings, and that they should only be taken up when the case for them was beyond doubt, and when it was proved that other measures have failed after due trial or were never likely to succeed.

Major James gave a short criticism of the paper which had been read by *Major Donovan*. He pointed out that it appeared to be of great importance to remove the misunderstanding that evidently exists in the minds of many people to the effect that a salt of quinine which is relatively insoluble in water must be, for this reason, much less effective than a soluble salt. It seemed that the fact was frequently overlooked that the stomach, where much of the quinine is absorbed, contains a more potent juice than water, and that in the small intestine any of the salt that is not dissolved and absorbed in the stomach is acted upon by the bile, which is an exceedingly powerful solvent of the drug. Above all it was a common practice to overlook the work of a large number of Italian, German, and French observers, who, with remarkable unanimity state that salts of the alkaloid, which are exceedingly insoluble in water, are absorbed equally as completely as the most soluble salts. He considered that in the light of recent work upon the absorption and elimination of quinine one might even go so far as to say that there are good reasons to believe that when administration is by the mouth the insoluble salts are more efficacious than the soluble ones. This belief rested chiefly upon the observations that an insoluble salt is absorbed somewhat more slowly than a soluble one, and that a greater proportion of an insoluble than of a soluble salt is eliminated in the urine. *Captain Macgilchrist*, I.M.S., working at Edinburgh University, had lately confirmed the latter finding, and it appeared obvious that if the useful portion of quinine is the portion that escapes destruction in the organs and is eliminated in the urine the more insoluble the salt we employ the greater will be its therapeutic value. He noted that *Major Donovan's* opinion in regard to the uselessness of quinine given intramuscularly was different from that of nearly all medical men in India and throughout the world. The annual reports by Medical Officers of both European and native troops in India contained numerous enthusiastic comments upon the great value of this method of administration. The unfortunate results in the case which *Major Donovan* referred might have been due to a neglect of the essential fact that in administering quinine by this method care must be taken to dilute the solution very greatly.

Major Donovan replied.

Mr. Narayanamurti said: As a layman I have read with interest the paper regarding the use of quinine, and though I am not competent to say anything on the scientific aspect of the question, I should like to say a few words based upon about 20 years' personal experience and observation in the malarious tracts of Ganjam and Vizagapatam.

I was rather confused and disappointed when I read the first portion of *Major James's* paper dealing with the problems relating to the use of quinine, but the concluding portion was encouraging. I have great faith in this remedy for malaria and have always endeavoured to induce others with whom I came in contact to use it both as a preventive and cure. I invariably used small doses of $2\frac{1}{2}$ grains pills as a preventive measure in the evenings and gave a pill or two to each of my clerks and chaprassies. I sometimes took a pill every other evening, for some time after returning from the malarious tracts. I am glad to say that by the use of the drug in the manner described I escaped fever altogether and my followers were also to a great extent free from it.

The President moved that the problems mentioned in *Major James's* paper and those which *Colonel Lukis* had detailed should be referred to a sub-committee composed of *Colonel Lukis*, *Colonel King*, *Lieutenant-Colonel Aldridge*, *Majors Rogers*, *Donovan*, and *James*, and *Captains Christophers* and *Gage*.

The motion was put to the vote and carried.

The following report was afterwards presented to the Conference by this sub-committee.

Recommendations of a Sub-Committee appointed by the Malaria Conference on the 15th October, 1909, to consider in regard to the general civil population of India (1) the doses of quinine that should be employed in order to cure the disease in the quickest time and with the least inconvenience to the patient, (2) the proper times at which the doses should be given, (3) the most appropriate salt of the alkaloid to employ, (4) the most appropriate mode in which to administer it, (5) the best plan of using the drug for prevention.

(1) In our opinion for the cure of adults in the quickest time and with the least inconvenience the amount of quinine to be given daily should be not less than 20 grains nor more than 30 grains of the sulphate, or not less than 15 nor more than 20 grains of the hydrochloride, or proportionate amounts of other salts which contain greater or smaller quantities of the alkaloid.

For children over five years of age half the doses recommended for adults should be given, and for children under five years of age the doses should be, for each year of age, one grain of the sulphate (or its equivalent in another salt), given the same number of times a day as will be recommended below for adults.

(2) In our opinion it is most convenient to give the 20 or 30 grains (or its equivalent in another salt) in two or three doses of 10 grains each during the day, and we consider that the doses should be given whether fever is present or not, but where convenient the 20 or 30 grains may be given in smaller doses at more frequent intervals.

(3) We recommend that after the attack of fever is over the full curative doses should be continued for three days, after which the daily dose should be reduced to five grains, which, with a view to prevent relapses, should be continued for not less than three weeks.

(4) The most appropriate salt of the alkaloid to employ is the hydrochloride or the sulphate. The hydrochloride contains a larger proportion of the alkaloid but is more expensive and being deliquescent is not so suitable for distribution in solid form.

For children either of the above salts may be used, or the tannate, which is, comparatively speaking, tasteless.

(5) Wherever possible the best mode of administering quinine is in acid solution, but we consider that for distribution to the general population quinine must be issued in solid form, and we recommend that for children a form as palatable as possible should be adopted.

(6) We consider that the best plan of using the drug for prevention is to take five grains of the sulphate, or its equivalent in another salt, every day (preferably in the evening) during the malarial season.

(7) In the treatment of cases of fever if the fever is not markedly reduced by taking curative doses for a week the patient is probably not suffering from malaria and the administration of quinine should be discontinued.

FIFTH DAY.

Saturday, October 16, 1909.

PRESENT:

The Honourable Sir Herbert Risley, K.C.I.E., C.S.I., I.C.S., President.
Sir Harold Stuart, K.C.V.O., C.S.I., I.C.S.
Cav. Filippo De Filippi, F.R.G.S.
The Delegates.

The President asked Colonel Lukis to read the recommendations of the Sub-Committee that sat on the 15th October to report on the subject of quinine.

Colonel Lukis read the recommendations which were accepted by the Conference.

The following paper was then read:—

A Revised Scheme for the distribution of quinine by Government. By Major E. Wilkinson, I.M.S.

In Eastern Bengal and Assam considerable attention has been paid in recent years to the distribution of quinine as a means of combating malaria, and since the pice packet system was introduced into Eastern Bengal in 1892 and into Assam in 1894, sales have been very large. In 1908 the number of packets sold was nearly $3\frac{1}{2}$ millions, the sales exceeding, I believe, those in any other part of India. It is probable that one of the chief causes contributing to this result is the liberal profit allowed to retailers. This is as high as 30 per cent., and as upon the unpaid retailing agency the success of any scheme of distribution must primarily depend, it is of first importance that their profits should be substantial. The amount sold for a pice was at first 5 grains. This was increased to 7 grains in 1904 and again this year to 10 grains, when compressed tablets were also made available, three tablets each of $3\frac{1}{3}$ grains being sold for one pice. In spite of these large sales available statistics give no reason to believe that in the Province of Eastern Bengal and Assam the distribution of quinine has made any appreciable impression upon malarial fevers. This failure I attribute to the fact that quinine is sold in doses and not in treatments, and that those who suffer very rarely subject themselves to continuous treatment. Dr. Bently in a recent paper lays great stress on this point and goes so far as to say that the plan of supplying quinine in pice packets has practically nothing to recommend it except that it is a system which has been in existence for some time. Malaria, he adds, cannot be cured with one dose of quinine, however large, and a sufferer who only spends a pice on quinine is practically throwing away his money. In his opinion the sale of single doses is only likely to mislead people and the policy of merely reducing the price, or rather of increasing the quantity supplied for a pice, is a mistake. He would therefore discontinue the sale of single doses and only issue packets containing from six to twelve unit doses. The Government of Eastern Bengal and Assam, following the recommendations made by Dr. Bently, has recently worked out a revised scheme of quinine distribution, the main feature of which is the distribution not of doses but of treatments, and this scheme I now propose to submit for the consideration of the Conference.

To be effectual, quinine must be supplied in adequate doses and the treatment must be maintained sufficiently long to prevent a recurrence. The cost of the treatment must not be excessive, the directions for use must be simple, and the drug must be issued in as palatable a form as possible, this last condition being especially important in the case of children. In considering what salt of quinine should be used, it will be useful to take the sulphate as a standard, both as to the amount necessary for effective treatment and as to cost, and to compare the other salts of quinine with it.

First as regards the amount required. The treatment of malaria described by Sir P. Manson and considered by him to be effective in 99 cases out of 100, requires as a minimum quantity 115 grains of the sulphate of quinine in solution. This treatment is spread over a week, the first dose being 10 grains, followed by doses of 5 grains every eight hours—that is to say, 25 grains are administered on the first day of treatment and 15 grains daily for the remaining six days.

It is important both for reasons of economy and for the avoidance of the toxic effects of quinine that the smallest effective dose should be prescribed, and Rogers has shown that no advantage is gained by giving more than 20 grains daily of the sulphate in solution. He has also shown that with such a dose the average duration of fever in malignant tertian infection is only 2·4 days and in benign tertian 1·44 days, the maximum duration in malignant infections being six days and in benign four days.

These two observers agree very closely as to the total number of grains required to cut short an attack of fever, and it may therefore be safely assumed that 115 grains of the sulphate administered in solution in doses of not less than 15 grains daily during the week, is an effective treatment for malaria. It is indeed not improbable that a minimum treatment of 100 grains so administered would be almost equally effective.

As regards cost the sulphate is the cheapest salt on the market, but, although it contains a fairly high percentage of the alkaloid it has the disadvantage of

being very insoluble. The accompanying table shows the solubility, alkaloidal content, dose, and price of the salts of quinine in common use: —

Salt of quinine.	Solubility in cold water.	Percentage of quinine contained.	Amount of quinine in a given quantity taking sulphate as 100.	Amount containing an equal quantity of quinine to that in 1 part of sulphate.	Dose in grains taking that of the sulphate at 5 grains.	Price per lb. (7,000 grains), in annas.	Price of effective unit compared with sulphate, in annas.	
							Actual.	Percentage.
1.	2.	3.	4.	5.	6.	7.	8.	9.
Sulphate ...	1 in 800	75.5	100	1.0	5	106	106	100
Bisulphate ...	1 in 11	59.1	80	1.24	6.2	125	155	146.22
Hydrochloride ...	1 in 40	81.8	110	.9	4.5	172½	155½	146.46
Tannate ...	Slightly soluble.	20.0	27	3.67	18.35	110	403	380.18

It will be seen that, taking the price of an effective unit of the sulphate at 100, the prices of the units of the bi-sulphate, hydrochloride and tannate are about 146, 147 and 380, respectively. If cheapness were the only consideration, the use of the sulphate would be clearly indicated. It is, however, of primary importance that the quinine administered should be absorbed and as, during fever, both digestion and absorption are usually much impaired, it is necessary either that quinine should be administered in solution, or that the salt employed should be easily soluble. Both Manson and Rogers prescribe the sulphate *in solution*. Distribution, however, in this form is not feasible, and we are forced, if we wish to obtain the best results, to make use of the bi-sulphate or of the hydrochloride.

It is now necessary to examine which of these two salts possesses the greater advantages. The cost in each case may be taken to be the same but the solubility of the bi-sulphate is considerably greater than that of the hydrochloride. On the other hand, owing to its smaller alkaloidal content, the dose of the bi-sulphate is considerably greater than that of the hydrochloride. In view, moreover, of McCay's observations as to the effect of sulphates in lowering, and of chlorides in raising, the hæmozoic value of the blood serum, it would seem that the hydrochloride is to be preferred, specially in regions in which blackwater fever occurs. For these reasons we propose in Eastern Bengal and Assam to make use of the hydrochloride for the treatment of adults in our revised scheme of quinine distribution.

It remains to determine the amount of the hydrochloride to be issued as a treatment. The actual equivalent of the 100 grain of the sulphate, previously mentioned as a minimum effective treatment, is 90 grains of the hydrochloride, the dose of the latter being 4.5 grains compared with 5 grains of the former. Owing however, not only to the much greater solubility of the hydrochloride, but also to its higher alkaloidal content and to its easier digestibility, a 4-grain dose may reasonably be taken as the unit, and it is proposed that the amount issued for a treatment should be 80 grains.

As to the form in which the hydrochloride should be issued, there is no doubt that tablets are preferable to powders. The exceedingly bitter taste of the drug would certainly interfere with its popularity if powders only were available, and this fact has already been recognised in the issue of small tablets of the sulphate in the two Bengals. Sugar coating would, of course, mask effectively the bitter taste of the drug, but it would add appreciably to the cost, and is moreover not recommended by the manufacturers on account of the liability of sugar-coated tablets to deterioration. Another disadvantage is that such tablets are liable to escape digestion. The treatment, therefore, suggested consists, as I have said, of 80 grains of the hydrochloride, made up into 20 uncoated tablets of 4 grains each. These would be administered in seven days, four tablets being given daily for the first three days, and two tablets daily for the remaining four days. Samples of these treatments, put up in glass containers, have been prepared by a firm of manufacturing chemists and are submitted for the inspection of the Conference. The glass tube is corked and the cork covered with paraffin in order that the tablets may be sufficiently protected; a label on the tube sets out the price of the treatment, and the tube would be enclosed in a paper containing a simple set of instructions for self-treatment in the vernacular. Ten of these treatments would be packed in a parcel and a parcel would be the minimum quantity sold to a retailer.

It is next necessary to examine the price at which such treatments could be sold by Government to the retailer and by the retailer to the consumer, and the loss

which Government would be called upon to bear. In making this examination it will be convenient to take a parcel of 10 doses as our unit, and I may mention that it is proposed that the manufacturers or their agents should undertake distribution to Civil Surgeons at a fixed rate of $2\frac{1}{2}$ per cent. on invoice charges.

The scales of prices and of profit and loss which has been provisionally worked out by the Government of Eastern Bengal and Assam is as follows:—

	Rs.	a.	p.
Actual cost to Government, including distribution charges			
to Civil Surgeons per parcel of 10 treatments ...	2	6	0
Price at which a parcel would be sold to the retailer ...	1	10	0
Price at which a parcel would be sold to the consumer at $3\frac{1}{2}$ annas per treatment	2	3	0
Retailer's profit per parcel ...	0	9	0
Loss to Government per parcel ...	0	12	0

The retailer's profit, after taking into account money order commission, works out to about 33 per cent. This may appear high, but it is not, I submit, excessive. Relying as we do on the services of an unpaid agency, it is essential to offer a profit sufficiently high to ensure that sales are pushed automatically, and it seems doubtful whether any scheme of distribution which does not satisfy this condition is likely to succeed. The consumer's price ($3\frac{1}{2}$ annas per treatment) is not, for the class of people in Eastern Bengal and Assam, which we hope to reach, excessive. Perhaps the most important figure in the table is that representing the loss to Government. This excludes charges incidental to distribution from district depots, but taking the loss at 12 annas per parcel, it would be possible for an annual expenditure of one lakh to distribute 1,33,333 treatments.

The next important feature of the scheme is the distribution of quinine in a form suitable for children, and no scheme for combating malaria can be considered complete which does not provide for this. It would be out of the question on account of their nauseating taste to make use of most of the salts of quinine, and it is necessary that the drug should be given in a form which will not only not be objectionable, but which may be sufficiently attractive to induce children to ask for it. This would be possible if a comparatively tasteless salt of quinine were mixed with some sweetmeat, as has been done in Italy, where, I believe, chocolate confections of tannate of quinine have proved highly popular. It is, however, doubtful, having regard not only to the deterioration due to the climate, but also to possible religious objections, whether this example could be followed in this country.

In spite of its many disadvantages, its insolubility, its low and variable alkaloidal content (with its consequent higher dose), and its indigestibility, the tannate appears to be the only tasteless salt of quinine which could be made use of in any widespread scheme of distribution. Euquinine and aristochinine would probably be equally effective, but their cost is prohibitive. For an adult an effective dose of tannate is about 18 grains, compared with the 5-grain dose of the sulphate. For a child of from 7 to 12 years of age the dose would therefore be about 9 grains, and the average dose for young children may be taken at 5 grains. As children find it difficult to swallow tablets it would be necessary to issue the tannate in powder form, and if the powder be mixed with sugar children would find it attractive.

The treatment for a child, it is suggested, should consist of 20 powders, each of 5 grains, of the tannate. These, separately packed, would be enclosed in a waterproof envelope, and 10 of these treatments packed in lead foil would constitute a parcel. I now give a scale of prices and of profit and loss similar to that already given for the treatments for adults. The figures are worked out on the basis of a wholesale quotation of 7 annas per ounce:—

	Rs.	a.	p.
Actual cost to Government per parcel of 10 treatments, including distribution charges to Civil Surgeons ...	1	1	0
Price at which a parcel would be sold to the retailer ...	0	7	0
Price at which a parcel would be sold to the consumer at one anna per treatment	0	10	0
Retailer's profit per parcel ...	0	3	0
Loss to Government per parcel ...	0	10	0

We propose to give to the retailer a somewhat higher rate of profit than that obtained from the sale of treatments for adults. Our object in doing this is that this important part of the scheme may have every chance of success from the outset.

At the same time the margin of profit should not be too great, as otherwise the danger would exist of retailers pushing the sale of tannate at the expense of hydrochloride treatments, and as the former only contain about one-quarter of the quinine necessary for the treatment of an adult, this result would not only cause unnecessary loss to Government but would prejudice the success of the whole scheme.

The next point to which I would refer is the stimulation of sales by extensive advertising, and the scheme which is being worked out for Eastern Bengal and Assam includes the somewhat novel proposal that there should be attached to the office of the Sanitary Commissioner a Publication Department which would be continuously and extensively advertising in the vernacular newspapers and by picture posters bring home to the people the advantages of continuous treatment. If we are to oust quack medicines and fever mixtures we must fight them on their own ground and appeal to the masses in the manner best calculated to impress them.

Side by side with the sale of quinine under the system I have outlined, it is proposed to undertake in malarious localities—and especially in localities where the people are too poor to afford the cost of a treatment—the free distribution of quinine by specially appointed hospital assistants or other reliable agents.

These, then, are the four main features of the scheme which I submit for the consideration of the Conference. The sale of single doses would be discontinued entirely, and in its place would be substituted the sale of treatments—treatments of hydrochloride being issued for adults and of tannate for children. Government would push its sales by advertisements and in specially selected localities free distribution would be undertaken.

I have not dealt with the important subject of the retailing agency, as this, I understand, will be separately discussed by the Conference. Although in Eastern Bengal and Assam we find that postmasters are our most successful salesmen, we cast as wide a net as possible and employ schoolmasters, members of village *panchayats*, *chaukidars*, and shopkeepers.

The following paper was then read:—

Experimental Demonstration Camps. By Major S. P. James, I.M.S.

It is now universally recognised that the problem of the mitigation of malaria in India is chiefly the problem of its mitigation in small villages, and it is therefore exceedingly satisfactory that the correct method of attacking the disease in those areas is no longer a subject of controversy. Differences of opinion in regard to the steps that should be taken in cities, towns, and even cantonments, are still justifiable, but all who have made a special study of malaria have arrived at the conclusion that the mitigation of the disease among the population of villages is to be accomplished by quinine alone. This decision has not been arrived at hastily or without due trial of other methods, but if these trials and probings after truth have caused delay they have enabled the verdict to be founded upon a firm basis of observation and experience. And indeed now we are aware that an advocate of anti-mosquito measures so ardent as Major Ross, has admitted that quinine measures are the correct ones to adopt in Indian villages, we may rest assured that the last word on the subject has been said and may betake ourselves immediately to devising schemes for popularizing the use of the drug in those areas. Such a task commends itself not only on account of the good results to be expected from a more extensive use of the drug, but because it is in continuation of the policy of bringing quinine within reach of the poorest inhabitants, which was commenced by the Government of India more than half a century ago. It is well known that the means then adopted with the object of cheapening the drug revolutionized the quinine industry of the world, and that, by the introduction about 35 years later of the system of selling pice packets of quinine at post offices, India became the first country to attempt a serious combat against malaria among native races. That as regards the great bulk of the inhabitants of this country the attack upon the disease must be attempted according to a plan of that kind, the people who are affected bearing, by the purchase of the drug at a cheap rate, a great part of the expense will be apparent to anyone who considers the enormous cost of any scheme which postulates a free distribution of quinine. Our primary object therefore is to devise a scheme for increasing enormously the demand for pice packets of the drug, and I propose in this note to treat very briefly of a plan that I think merits trial with this object. The plan that I recommend is the establishment in selected areas of every province of what may be

called experimental demonstration camps—experimental because they would form a means of testing the value of quinine for the mitigation and prevention of malaria among the general population, and demonstration because their primary object would be to demonstrate to the people the benefits of the drug and the correct way in which to use it. It is certain that at present, even if the villagers of India generally are aware of the existence of a drug like quinine, not a fractional proportion of them know where this medicine is to be obtained, or how to use it, or what great benefits its use would confer upon them, and it seems to me that in the first place it is our duty to teach the people these things.

The following are some headings that may serve to indicate the principles on which the camps should be initiated:—

1. If possible a camp should be established in each district of a province. It should be situated in the most malarious part of the district and its operations should be confined to a population not exceeding 2,000 people.

2. The staff for each camp should consist of one selected hospital assistant and one compounder.

3. One Medical Officer should be appointed for the supervision of all the camps in a province; he will tour from camp to camp, staying a few days at each.

4. On arrival at the selected area the staff of the camp will establish themselves in a house or tent in the centre village of the area, and their first duty will be to make it known to the people that they have been appointed by Government to treat anyone who may be suffering from fever. For two or three weeks they will confine themselves entirely to the task of endeavouring to cure as quickly as possible those who voluntarily seek their aid. By this means the purpose of their visit will become known and the confidence of the people will be gained.

5. Afterwards they will work on a more systematic plan, and in the first place will secure by a house to house visitation: (1) a census of the people by ages and sex; (2) a list by names, ages and sex of everyone who is suffering from fever or enlargement of the spleen.

6. The task of curing all these people will now be begun in earnest. The work should be shared by the two officers, but I think that as a rule the compounder should remain at the camp in order to treat all who can attend there, and the hospital assistant should spend the day in visiting and treating all who cannot or will not leave their houses.

7. *The essential feature of the campaign will be the treatment of all patients with the quinine put up in the pice packets that are sold at post offices.* Whenever anyone requires a dose of quinine the hospital assistant or compounder will show him the pice packet, will open it in his presence, and while the dose is being taken will explain to him the way in which it is to be used for both treatment and prevention, and where, and at what price it can be obtained when the camp has ceased to exist. This little lecture should be prepared beforehand and should not vary in any detail; by its constant repetition the people will learn how to use the drug for themselves and by the time the camp has ceased to exist it will be possible to say that, at any rate, among the 2,000 persons in the area of operations, there is no one who does not know where to obtain quinine and how to employ it. The hospital assistant will also demonstrate to the people cases of enlargement of the spleen and from time to time will show them how remarkably the organ decreases in size as a result of the treatment. From my experience in Mian Mir I know that this is an easy and sure method of getting the people to understand the benefits to be derived from quinine.

8. This brings us to the important subject of the dosage that is to be adopted for treatment and prevention. In the first place it is essential that in a camp of this nature all patients must be treated in exactly the same way so that no confusion on the matter will exist in the minds of the people. It is not possible here to discuss the various methods of treatment that might be adopted, and I will only say that in the present state of knowledge, and having regard to all the circumstances of the problem, it seems to me essential that for the treatment of patients we should adopt the principle of giving small doses of the drug at frequent intervals. With this object I recommend that *each packet should contain four grains of quinine and that five of these packets will be the amount of medicine required for 24 hours*, the doses being given at sunrise, morning, midday, afternoon, and sunset. When the hospital assistant sees a patient he will administer one dose to him, will deliver the little lecture already mentioned, and will then hand over to him a sufficient number of packets to last until the next day, or the next day but one, according as the pressure of work enables patients to be seen every day or every other day.

9. It is for consideration whether packets of tannate of quinine should be used for the treatment of children. If this were done the doses should be enclosed in an envelope of a colour different from that of the packets used for adults. The introduction of an arrangement of this kind would simplify the instructions greatly.

10. The hospital assistant will not confine himself to the treatment of cases, but will do his best to push the use of the drug for prophylactic purposes. To take one packet of four grains of quinine every night is the best way to employ the drug for this object, and I see no reason why, with tact and perseverance, a number of the healthy inhabitants of the area should not be induced to adopt the measure in order to convince themselves and their neighbours of the efficacy of the drug for this purpose.

11. A feature of the campaign will be the constant endeavour to interest the inhabitants in the scheme by frequent demonstration of its benefits, and to this end I think it should be the duty of the inspecting Medical Officer to address the people at each of his visits. I cannot enter into detail regarding these addresses here, but it will be obvious that at the first address he should explain the present state of the area, should give some idea of the number of people who are suffering from fever or enlargement of the spleen, should describe the measures that it is proposed to employ to show the people how they can help themselves to stamp out the evil, and should explain to them that, though the treatment will be entirely free while the camp is in their area, they will have to purchase the drug when the camp has ceased to exist: and that at the last address before the closure of the camp he will review the results that have been achieved, will explain how they have been brought about, and will make it plain that if the people continue to use the drug in the way that has been demonstrated to them they need have no fear of malaria. He will explain to them yet once again that a large supply of the drug has been left either at the post office or at the principal shop, as the case may be, and that its price is two doses for one pice. In front of this post office or shop should be erected an advertisement board stating that "Government quinine is sold here."

12. I consider that from six weeks to two months should be the length of stay of each camp in the selected area and that at the end of this time the camp should be moved to the group of villages adjacent to the area already dealt with. By this arrangement the influence of the camp will not be suddenly and entirely lost. Assuming that a camp remains two months in each area of 2,000 people, 12,000 people would be educated per annum, and assuming that a province contains 30 districts, each with its own camp, the number of people educated yearly would amount to 360,000. If a camp were started in each district of British India about three million people per annum would learn thoroughly the benefits to be derived from quinine, where to obtain it, and how to use it.

13. In considering the cost of this scheme it has to be remembered that the outlay is not a recurring one for each area dealt with; once the people of an area have received their two months teaching the only expense is the small loss that might result from the sale of quinine at less than cost price. It has to be remembered also that the charge is really for the purpose of teaching the people how they can save themselves from misery and death, and that from any point of view it is more important to instruct them upon such a subject than it is to instruct them in the arts of reading and writing. If we assume that the consumption of quinine in each camp would be 1,000 doses a day, it would be allowing a considerable margin for incidental expenses to assume that, including the salaries of the staff and the supervising Medical Officer, Rs. 350 per month would be the cost of each camp. Considering the benefits that might accrue this is not a great sum.

14. It seems to me that the scheme I have roughly sketched out is one which should appeal not only to Governments but to private philanthropy. At the present time when there exists in this country so strong a feeling that to mitigate malaria something must be done, it is at least of importance for the charitable to know that Rs. 1,000 expended in the way I have described, might be the means not only of saving a considerable number of lives, but of alleviating directly and indirectly an incalculable amount of suffering and misery.

15. Finally I put forward the scheme as an attempt to solve the problem of free distribution of quinine. I think the futility of distributing quinine to village headmen for indiscriminate use among the people must be patent to all, and that it would be a good principle to distribute no quinine free in this country except through an agency somewhat similar to that which I have described. If this principle were adopted the authorities would obtain an adequate return for the expenditure

incurred, the return being the knowledge that the distribution was being beneficial, and that by its means the people were being thoroughly educated in the manner of saving themselves from death. In the attempt to mitigate malaria in India, Governments and other authorities have an obvious duty to perform, but the duty is not limitless, and personally I think a considerable part of it will have been done when, after teaching the people how to use quinine in a proper manner, the drug has been everywhere made available to them at the cheapest possible rate.

The following discussion ensued:—

The President said: It happened in 1892 that I started in Bengal a system of selling quinine in pice packets at post offices. I had the greatest opposition to meet; people saying absurd things, one of which was that postmasters would take the trouble of opening several thousand packets—not easy packets to open by the way—and that they would extract the quinine, would sell it and would substitute something else. I do not believe this has ever happened. The principle, as Major Wilkinson has explained, was that for the smallest coin in use quinine should be available at places which people frequent. The results were shortly revealed. I think three years after the system was started by Government it was found that the demand in each district appeared to bear a definite relation to the amount of malaria; that is to say, that, in the most malarious districts, the demand per thousand of the population, or whatever the system of calculation was, corresponded with the malarious character of the districts. Jessore ranked very high, also Rajshahi, exactly the places at which you would expect that the drug would be most necessary. The people were advised by printed instructions on the packets how to use this treatment. The plan has now been in force for a great many years and has worked well; the post office is a place which a great many people frequent and in many villages it really is a sort of club; the people go in and talk about their affairs; it is a very popular place. Are we now going to displace this system, or is it possible that the system can be modified in some respects so as to fit in with more modern ideas as to the proper mode of using and distributing quinine?

Mr. Ferard said that there was a Conference last year in the United Provinces about the best method of distributing quinine; the subject of travelling dispensaries was considered and it was not accepted as it was found to be very expensive. In ordinary times in the United Provinces pice packets are sold; they are distributed by village accountants, vaccinators, sub-treasury officers of Tahsils, sometimes the agents of zamindars, subordinate officials of the Canal Department, schoolmasters, and in fact the most trustworthy officials of various Government departments. In addition, officers on tour and supervisors of accounts are given pice packets to sell. A commission of 1 per cent. is allowed. He might safely say that in the United Provinces there is not a village of which the adult members do not know where they can get quinine. Every village has an accountant and a post office. The amount of quinine taken was considerable and was increasing. All this was done in ordinary times. The question arose as to what was to be done in periods of epidemic. The Lieutenant-Governor has decided that a supply of quinine should be given to officers on tour, that is the assistant collector, assistant tahsildars, and supervisors of village accountants who should each have a circle of about 100 villages; their tours coincided with the beginning of the malaria season. The distribution was free. In addition the most important method of distribution was the non-official agency which consisted of village headmen. In the fever epidemic of 1908 in some parts of the province a considerable amount of quinine was distributed in this manner, by zemindars personally and by their agents. The consumption of quinine does not vary with the degree of malaria in a district; it depends on the education of the people. As a matter of fact the amount was increasing. Experiments were being tried of giving quinine gratis to school children in certain districts. In ordinary non-epidemic times every possible agency of Government was utilised to sell these packets. In epidemic times non-official agency was also very largely employed. He did not think demonstration camps were really required in the United Provinces, though they might be elsewhere.

Mr. King described a scheme which had been adopted in the Gurdaspur district of the Punjab in 1908. A quinine distribution association was formed which was taken up keenly by the educated classes, who worked hard to make it a success. The organisation was somewhat similar to that of the Blue Ribbon Army, the rules being that each member bound himself to take quinine once a

week and to induce as many other people as possible to become members of the association. Each member had to pay a subscription of six annas a month to cover the cost of the quinine, but in addition there were non-paying members from among the poorer classes. As a rule, however, it was considered a point of honour to be a paying member. The lambardars enrolled members and collected the subscriptions, which were transmitted to the central office at Gurdaspur. Some of the larger land-holders and zamindars had actually proposed that it should be a condition of tenancy for all tenants to become members of the association. Commissioner Booth Tucker of the Salvation Army had taken up the scheme keenly and his efforts had led to a large increase in membership and to the enrolment of people who could not be reached by other agencies. The total cost of the quinine distributed to members of the association since June, 1908, was over Rs. 15,000, and at the end of the year the books showed a profit of seven rupees. He considered that as an experiment the scheme had been entirely successful.

Mr. Sunder Lal said that the United Provinces was divided up into circles, and in an epidemic each circle was placed in charge of a member of the district Board. A list of the headmen of villages who were prepared to distribute quinine was then made. Superintendents of the different circles were collected, and instructions given to them by the medical authorities, also printed instructions. This scheme was put in hand long before an outbreak, and on an epidemic occurring work could be started at once. The quinine was to be distributed in 5-grain pills.

Mr. Lawrence said: In regard to the sale of quinine there are three points I wish to bring to the notice of the Conference. You are no doubt aware that our proceedings here are viewed with the gravest suspicion by certain sections of the Indian public. It has been suggested that this Conference is a gigantic fraud convened to cover a financial swindle. It is pointed out that whereas the market price of quinine is Rs. 8 per lb., Government are selling it at Rs. 14. Now where does the balance go to? One theory is that since the Indian Government is known to be bankrupt, our President has conceived this device for replenishing the exchequer. A more popular theory is that a Simla Ring has cornered the world's supplies of quinine and proposes to make millions out of the dire necessity of the *ryot*. I am sorry to see that this latter theory will receive support from an innocent expression used in a recent letter by Major Ross in the *Times*. Major Ross has predicted that this Conference will go solid for quinine, firstly because the medical mind is incapable of appreciating the value of anything except medicine, and secondly "for other reasons." Now to the Native editor pondering the problems of the Empire, there is a world of meaning behind these few words of dark mystery. It is clear to him that Major Ross is on the track of a secret conspiracy. To disarm these apprehensions I submit that arrangements should be made to sell Government quinine to Local Bodies at the current market price.

Sir H. Stuart: The price of quinine is fixed for the year at the average price of Howard's quinine for the previous year.

Colonel Lukis: The price of quinine is not now as high as Rs. 14.

The President: Where does Mr. Lawrence obtain this figure from?

Mr. Lawrence: It is given in the native press; and you will find it also in the report presented to the Conference yesterday under the orders of the Inspector-General of Hospitals, Punjab. Within the last month I have myself bought quinine pills for the Local Board of Sukkur from the Government Medical Stores at Bombay at about this price.

Colonel Lukis: The price of pills is higher than the price of quinine, but a mistake has been made in the price quoted.

Mr. Lawrence: My second point is that an estimate should be made of the available supplies of quinine, and arrangements made for the effective organisation of the distributing agency. Last year when the Punjab Government distributed some 6,000 lb. it is well known that difficulties were experienced in meeting this demand. Last October, when I required the small amount of three pounds from the local depôt at the Hyderabad jail in Sind, it took nearly a month to supply me. There is a danger that when we have set up an elaborate machinery for distribution, work may be brought to a standstill for want of quinine.

The President: There was plenty of quinine at the factory.

Mr. Lawrence: There may have been. My third point is that the method of organisation of the retail distribution of quinine should be left entirely to the

local Government. In the paper with which the Sanitary Commissioner opened these proceedings a special Malarial Committee was proposed, and it was suggested that this Committee should control the distribution. This form of centralisation would certainly not be effective.

Colonel Leslie: The Committee is stated to be under the local Government.

Mr. Lawrence: The proposal is that the Committee should report to the Sanitary Commissioner with the Government of India.

Colonel Leslie: The object of the proposal is misunderstood.

Mr. Lawrence: I am glad to receive this assurance. As it stood, the proposal appeared to be a grave departure from the recommendations of the Decentralisation Commission of pious memory.

Major Rogers: In the Government of India Resolution of 1903 the figures showed that the distribution of pice packets from 1892 to 1900 in Bengal was ten times as much as in any other province. I desire to refer to two experiments, one in regard to the use of quinine as a prophylactic, the other in regard to its use as a cure, which have been recently made in this province. The experiment in the use of quinine as a prophylactic was made in a small rural municipality of about 3,500 inhabitants; the population had decreased in the course of 18 years from 4,600 to 3,500; they were practically dying out of malaria. In this place an Assistant Surgeon was put on duty before and throughout the malarial season; he went from house to house and saw the people take the quinine tabloids himself. But in July he distributed only 600 tabloids in 200 houses, in the next month 450 tabloids in 40 houses, and in the next the people in only 30 houses would take it. It was clear that the people would not take the drug for prophylactic purposes. This distribution was an absolute failure.

The other experiment was made in some of the most unhealthy *thanas*. A system was established of itinerant Hospital Assistants with a small dispensary. There were 17 Hospital Assistants in the first year and 19 last year. The experiment was limited to small areas, one or two Hospital Assistants to each *thana*, so that they could go round to the villages at frequent intervals. This plan has been highly popular and the people have asked for it to be extended. It has certainly educated the people as to the value of quinine. The Hospital Assistants have succeeded in getting the people to take the quinine as a curative but not as a prophylactic. Mr. Ferard's remark that in the United Provinces there is not a village without a post office and not a village in which the adults do not know where to get quinine cannot be applied to Bengal. My enquiries in Dinajpore showed that in a tract of 150 miles there were only 43 post offices. In large areas the people were cut away from the Post Offices which distributed the quinine, and I said that it was necessary to have a much wider distribution. I suggested village school-masters because I found that three-fourths of the deaths occurred amongst children. An arrangement was then made for the formation of centres all over the province and it was settled that no village should be more than 5 miles from a centre. The results, however, had not proved successful in extending the sale of quinine. I suggested the payment of a fair profit, but my suggestion was not accepted and the system had failed for that reason. Mr. Oldham had lately reviewed the position in Bengal, and concluded his remarks by saying: "What strikes one most is the spasmodic and disconnected character of the measures taken and the want of system by which sustained and continuous efforts towards popularising the scheme would be assumed." Under the present system the pice packet contains 10 grains in Bengal. This means a loss to Government. Sir E. Baker has faced that and given a grant to cover it. We have adopted a system somewhat similar to that recommended by Major Wilkinson, 8 doses being sold in one packet for 2 annas, and in each packet there is a printed form describing how the quinine should be taken. As regards Major Wilkinson's suggestion, I think the pice packet and the treatment system should be allowed to run side by side. I think it would be a fatal mistake to do away with the pice packet system in Bengal at present, as the pice packet is well established and popular there.

Mr. Nathan desired to say a few words in support of the change of system recommended in the paper read by Major Wilkinson. The President had said that the problem for consideration was whether the pice packet system was to be abandoned or remodelled in any way. In his opinion the pice packet system had been a great failure both from the point of view of sales and of effect and in Eastern Bengal and Assam it was now desired to remodel it, as had been explained

by Major Wilkinson, and to introduce a system which he thought would become more popular. He thought there was no doubt of the failure from both points of view; in Eastern Bengal and Assam more quinine was sold than in any other Province and still the local Government were so impressed with the uselessness of the present system that they desired to modify it. Looked at numerically, he took the instance of the United Provinces, and in spite of the admirable organization and the numerous agencies which had been described by Mr. Ferard the actual sale in 1907, as compared with the population, was infinitesimal, 722,000 doses, a negligible quantity. To show how small the figure was he instanced the case of Backergunge in Eastern Bengal and Assam, where in 1908 in a single district 2 million doses were sold, nearly three times that of the sale in the whole of the United Provinces during 1907. Other provinces showed similar poor results. It was said that they were destroying a great agency that at present existed, but considering its want of success, he did not think it was a great agency.

Next as regards the question of utility, he again instanced Backergunge where an experiment had been made on a larger scale than anywhere else; two million doses were sold in 1908, which was twice the amount in the whole of Burma. Then as to results, Captain Scott, Civil Surgeon of Backergunge, informed him that no one in the district took quinine in sufficient quantities to do the slightest good; the whole of the expenditure incurred on this system there was held to be a waste. That being so, it was surely time to modify the system. Captain Scott was not alone in his opinion. Dr. Bentley held the same view and his experience was very great. All the authorities in Eastern Bengal and Assam who had dealt with the matter held this view. Major Rogers had made the suggestion that the two systems might go side by side. If the two quantities were sold side by side, the one costing a pice and the other three annas, the probability is that the cheaper one would be bought to the exclusion of the dearer. Then as regards the manner of distribution, in Eastern Bengal and Assam the Post Offices are largely used, and other agencies similar to those mentioned by the Commissioners of Allahabad, should be encouraged—above all, masters of primary schools. If they could get children to take the quinine a great deal would have been done to modify the effects of malaria. In addition to the official agencies, he hoped, as time went on, they would employ private vendors more largely. The profit at present amounted to 6 annas on 102 packets. The Civil Surgeon at Backergunge said that in that district about half the sales were through the Post Office and half through private vendors; that was to say that by the system of private vendors there was a larger amount sold than by the whole of the organisation employed in the United Provinces. This was a point that needed special attention. The private vendors got their supply from the Civil Surgeon. The jail supplied the Civil Surgeon.

Mr. Chaudhri said: While strongly endorsing all well-planned methods to popularise quinine the education of the people on the subject should not be lost sight of. In my humble opinion, it is one of the chief ways—if not the most important—of bringing home to the people at large the benefits of such a well-known prophylactic against malaria as quinine is. Whatever measures might be adopted about the form, preparation, sale or free distribution of quinine, the best and never failing method will be to educate the people. It is admitted that there are quacks who, in praising their own specifics for fevers, speak adversely of quinine, while there are people who have strong prejudices against quinine. I know from experience in my part of the country, the cultivators and ordinary labourers when advised to take this drug, say that quinine and such like medicines are never meant for them and they go in preference to *ojhas* or village quacks. Hence it is absolutely necessary to educate the young and the old on this subject by means of lessons introduced in the school books and by leaflets, health series, and popular lectures. The school-going population of the primary standard who are to be the future citizens of the Empire and who are likely to influence their parents and relatives as to the uses of quinine should have booklets introduced containing lessons in all the vernaculars on the uses of quinine, including suitable lessons on village sanitation and simple rules of hygiene. I understand from the Sanitary Report of 1908, the Eastern Bengal and Assam Government has undertaken to introduce lessons on quinine. The preparation and publication of *health series* in the vernaculars written in easy style comprising lessons not only on quinine but on sanitation and hygiene should be the next step aimed at. The health series should

in its initial stage be offered at a reduced rate and in some places free distribution should be indulged in. To reach the masses in the remote villages leaflets written in clear and easy language should be printed in all the vernaculars which should be meant not only to accompany the sale of the best quinine treatment adopted but should be distributed broadcast in large numbers by intelligent distributing agencies. In all these methods, the co-operation of the people is necessary. The services of the leaders among the people in the various centres of the provinces should be secured to co-operate with the special staff or committee under the supervision of the Sanitary Commissioner to deliver lectures in localities affected with malaria and where literature on quinine treatment may be exhibited for sale and thus gradually extend the operation to places less affected. Popular lectures by Hindu and Mahomedan leaders under the auspices of the Sanitary Commissioner will go a great way to strengthen the operations to introduce and popularise the use of quinine.

Car. Filippo De Filippi in reply to a request by the President that he would describe the system of distribution in Italy said that he had not made a study of the subject, but he believed that the Red Cross Society under the Geneva Convention go out to the Campagna and pitch a camp in a malarial district, and stay there the whole of the season, the next year they go to another district and so on; the Society was not numerous enough to conduct operations on a very large scale.

Major Wilkinson said that he had spoken to an Italian doctor from Calabria who said that the prophylactic operations conducted by the Italian Government had been exceedingly disappointing. They could not get people to take quinine in the belief that they would thereby protect themselves.

Mr. Ferard said, with reference to the remarks of Mr. Nathan, that the full organization sketched for the United Provinces was only decided on the 2nd of June, 1909. The heads of the organization were post-masters, vaccinators, village accountants, supervisors or *kanungos*, stamp vendors, sub-treasury agents, landlords, agents and canal officials.

Mr. Cholmeley said that Burma had got a reputation for fever which was underserved. The Province was divided into the wet and dry zones. The fever death-rate in lower Burma was 10 per mille and in Upper Burma it was very seldom above 8. He understood the death-rate for India was 19, so that the reputation Burma had got was unfounded. Since the annexation conditions had improved; this was due to the gradual clearing of the jungle since 1885 and to the construction of drains, &c. He mentioned some districts which were formerly malarious and in which conditions were now different. The sale of quinine was very small, in 1908 the total amount was 478 lb. That did not go far in a population of 10 million; the larger part was sold in Lower Burma. He read the rules as regards sales. The distribution was through vaccinators and headmen of certain selected villages, *tehsildars* when on tour, and post-masters. The only change that had been suggested was that powders would be replaced by pills of $7\frac{1}{2}$ grains. He read a Resolution on the subject of the vendor's profits. No doubt the sale should be extended; the headmen should be induced to push the sale by giving them a larger profit than at present. The sale might also go on in drug shops.

In reply to a question by the President as to whether the priests might be induced to take it up, seeing what they had done for education, he was doubtful if it could be done.

Captain Baket explained that such a system would not be feasible as priests were not allowed to handle money.

Mr. Cholmeley went on to say that they had no malaria epidemics in Burma. Since such distribution as had been made, he had noticed no difference in the death-rate. He agreed with the President that malaria was not so bad in Burma as to need any particular measures.

Mr. Maude asked if it was an established fact that 10 doses were necessary for the cure of malaria. He had cured his servants and others on many occasions with less than 10 doses. If the necessity of 10 doses in all cases was not established then Major Wilkinson's proposal to issue only treatment quantities seemed to fall to the ground. It would be a great mistake to give up the issue of pice packets the sale of which had been steadily increasing and substitute for it another method. One could not escape the conclusion that if the pice packet method were abandoned, there would be an enormous fall in the sale of quinine throughout

Bengal. Since the Government resolution which Major Rogers quoted had issued, there had been a steady increase in the sale of pice packets, and there was strong evidence that the increase was due to the purchase not by ordinary people, but by quacks, *baidis* and *hakims*.

Colonel King said that he agreed with Mr. Cholmeley in his statement that there was no fever in epidemic form in Burma as in the Punjab. Such malaria as they had was localised and therefore did not swell the general statistics of the province. It had declined in respect of disciplined bodies such as troops, military police and prisoners, as the result of judicious use of quinine prophylactically, combined with local improvements of drainage, and the use of mosquito nets among about 13,000 or 15,000 people. Particulars on this subject would be found at pages 5 to 7 of his report. From Major James's paper it would appear that he would lead us to believe that Major Ross would apply the use of quinine to villages indiscriminately, that is to say, if a place be malarious, and it be a village, practically no other measure would be adopted. He did not think that was Major Ross's intention. This matter was of very great importance and he would like to quote Major Ross's own words as given in his recent letter to the *Times*. They were as follows:—"I do not decry quinine prophylaxis; there is no real rivalry between it and mosquito reduction, and each ought to be used in its proper place—as I have described at length in various publications. Our great object is to combat the disease by every means in our power; but it will be a disaster for India if those who advocate a sole and universal quinine prophylaxis succeed in suppressing other and sometimes more appropriate measures. We can only hope, therefore, that full opportunities will be found at the conference for the expression of wider views. There appears not to be a single engineer among the members originally nominated. Medical men are apt to be biased towards quinine prophylaxis because they naturally understand medicines better than drainage and public works—and for other reasons." He suggested that the correct interpretation of the words "for other reasons" was not that implied in the sinister bazar rumours which Mr. Lawrence had mentioned but had reference to the well-known fact that provincial Governments had difficulties of a financial nature in meeting sanitary requirements.

Colonel Lukis said, that in regard to the measures which were appropriate for villages, it was difficult to gather Major Ross's opinion from the extract quoted, and that in circumstances like the present it was unwise to rely upon correspondence in lay newspapers. He therefore thought it right to quote, from a reprint of Major Ross's speech at the Bombay Medical Congress, the following extract which appeared to express clearly Major Ross's view as to the correct measures to adopt in Indian villages. "For scattered populations, small villages, and rural areas we must generally fall back upon quinine, because the cost of drainage is likely to prove too much in comparison with the benefits likely to accrue from it."

Major Rogers said that experiments upon the use of quinine as a prophylactic had been made among the police in selected areas in Bengal. They had been made in the most malarious places and gave evidence of the great value of the drug for the purpose.

Colonel Dyson said that in Bombay the system of the distribution and sale of quinine was as yet in its infancy and there were no figures to offer. There were differences in the Presidency as regards the malarial areas. In Sind people were beginning to recognise the value of quinine and there perhaps such an agency as Major James had suggested would be of value, but there were other places, for instance, the jungle tracts of the Panch Mahals and North Canara, which were absolutely new ground. In the latter place pice packets had been placed at the disposal of the people and had been found just as they were handed over to the village authorities, unopened and mouldy. In such parts it was considered almost hopeless to overcome the apathy of the people, and what was wanted was some stronger agency for the distribution of quinine. The suggestion was that travelling dispensaries should be used; they were tried and were closed this year as they were considered to have failed. He thought there were sufficient reasons to explain this failure. In the first place, no trouble was taken in the selection of the hospital assistants in charge of the dispensaries; certain centres were allotted and were too large; the experiment was continued for the period of two years, and it was considered that the cost of the experiment was too great. He thought, if travelling dispensaries were properly organized and

the hospital assistant properly selected and sent round in the worst time of the year, if, moreover, some special concessions in the way of pay, promotion, or allowances were given them, and the area restricted, the experiment might succeed. He would suggest that the area should be such that the hospital assistant would be able to visit each village at least once in a week or ten days, so that he could reappear at each spot about four times in a month. It had to be remembered that in these tracts even Western medicines were unknown, leave alone quinine. It was exceedingly necessary to have continuity in such matters; if the travelling dispensary system was to be tried again, the men selected should remain there for a period of years so as to get used to the people and to teach them the use of quinine. The men should be selected carefully. It had also to be remembered that as regards the distribution, there would be difficulties as there was no such thing as a village site; the villages consisted of isolated and scattered groups of huts; there were no schools, no post offices and no shops, so that teaching in regard to the use of quinine would have to be very thoroughly undertaken. Further, the distribution would be through the headmen and the sale would be at a market town. He again emphasized the necessity of continuity if any benefit was to be derived from the measure. The Bombay Government had decided to continue a further trial of travelling dispensaries.

Mr. Weir said that in Madras the distribution of quinine was left to the agency of the post office. The sale was not large. In Madras there was no malaria in epidemic form, and so it was not necessary to take the same measures as in some provinces. The worst cases of malaria were generally in hills and forests inhabited by wild jungle tribes, and no quinine could get there, no matter what agency was employed. In some places perhaps some of the agencies mentioned could be employed, for instance, schoolmasters, vaccinators, &c. In affected areas the Government had deputed hospital assistants to distribute quinine.

Mr. Fox-Strangways said that figures for the Central Provinces were very small. They issued quinine through the post office, schoolmasters, stamp vendors, and in five districts through *patwaris*. The total amount in 1905 was 365,000 7-grain pills. In 1908 the figure was rather less than one-third of that given. There were some reasons for this decrease; one was that the commission given was $1\frac{1}{2}$ annas as against 6 annas in some places; another reason was that the people were offered something different to what they were given in a hospital, and this puzzled them. There should be no difference. The methods for improvement which they should employ would be to increase the amount of commission, extend the *patwari* system, and enlist to their aid other agencies. They did not nearly enough employ the police, forest, and revenue officers and other Government servants. He considered that the most promising way of pushing the knowledge of quinine was not by taking areas specially liable to the disease, but by trying to induce the whole population to believe in it and to spread it by means of Government officials.

Mr. Mudholkar would not discontinue the system of pice packets. There were many people who would find it impossible to spend large sums but who could afford to buy the pice packets.

Mr. Goswami was of opinion that the two methods should proceed side by side; they had been found successful in Bengal.

Mr. Choudhri said that if the expensive and cheap methods were displayed side by side, people would only buy the cheap one.

Mr. Wadhia said that in Bombay they had been distributing quinine gratis, but very often people made no use of it. It was frequently found stored up as received; in some cases it had actually been sold in the bazaar for what it would fetch.

Captain Gage in reply to a question by the President said that in Bengal if they took up the present new extensions, they could grow enough bark to produce 50,000 lb. of quinine per annum. On the eastern side of the Teesta there were 5,000 acres of culturable land, but they were not likely to get enough land in Bengal to get the outturn to reach 100,000 lb.

Mr. Weir said that he believed in the Nilgiris there was a large area suitable for the growth of cinchona, and if the demand made it worth while planters would grow cinchona.

Sir Harold Stuart said that taking 250 grains as the amount of quinine required for each person as a prophylactic during a malarial season of 90 days 100,000 lb. would be required for 3,000,000 people for prophylactic purposes. The amount required for cure was about the same. Major Wilkinson had proposed only 80

grains while the Sub-Committee proposed 240, but Major Wilkinson had not provided for the after treatment.

Captain Gage said that the production in Madras was mostly from imported bark, but in Bengal they would in two or three years be able to harvest sufficient bark for 50,000 lb. of quinine. In the south if the planters raised their grade of bark 5 per cent. it would pay, but the culture in the south was rapidly going down. There would be no difficulty in manufacturing 100,000 lb. at the two factories, given the facilities. If quinine was required for 30,000,000 people, there would be difficulties, and it would be necessary to go into the open market; that would send up the price considerably. The world's total output of quinine was a million pounds, and that figure has been stationary for some years.

Sir Harold Stuart, in reply to a point raised, explained that local Governments were not allowed to go into the open market for quinine.

Captain Gage said that it was not possible to get better quinine in India than that turned out in the Bengal factory. Should it be required, there would be no difficulty in turning out hydrochloride, but it would be half as expensive again.

Sir Harold Stuart observed that it had already been explained that the price of Government quinine was based on the price of quinine in the previous year. It had to be remembered that the price of quinine was affected by the existence of the Government factories, and the view held by the Government of India was that it was not asking too much of local Governments that they should be prepared to pay a somewhat higher price as an insurance against a rise in the price of quinine.

Mr. Nathan thought that any measures in connection with obtaining quinine in the open market should be conducted by the Government of India; it would be most inconvenient for the local Governments to compete against one another in the local markets.

Captain Gage said that they could turn out a certain amount of hydrochloride for experimental purposes; they might turn out 5,000 lb. The cost would not be very much. Sulphate was made in the first instance and had to be converted into hydrochloride.

The President presumed that hydrochloride was to some extent experimental. It seemed undesirable to start plant in Government factories if there were any uncertainty in the matter.

Sir Harold Stuart remarked that the Government factories would be fully occupied in turning out sulphate, and hydrochloride should therefore be obtained in the open market.

Captain Gage said that they charged the Jail Department wholesale rates; the cost price was Rs. 7 per pound. The rate at which it was sold was Rs. 10; he said that there was a profit of Rs. 3 on the pound, but the profit was wholly swept away by the pice packets.

The President then read out to the Conference the rough drafts of recommendations and resolutions on which he invited suggestions. The discussion which followed was concerned only with changes in phraseology.

SIXTH DAY.

Monday, October 18, 1909.

PRESENT:

The Honourable Sir Herbert Risley, K.C.I.E., C.S.I., I.C.S., President.
Sir Harold Stuart, K.C.V.O., C.S.I., I.C.S.
The Delegates.

The President read the following paper:—

Popular co-operation in the prevention of Malaria, by the Honourable Sir Herbert Risley, K.C.I.E., C.S.I., I.C.S.

At first sight it seems preposterous that any Conference, however well equipped for the purpose, should dream of handling the problem of malaria within the inside of a week. That is what the outside critic, not necessarily familiar with the literature of the subject, might naturally be expected to say. But in reality the scientific

portion of the field has been very thoroughly prepared for us by the enquiries of Laveran, Manson, Ross, Grassi, Schaudinn, Koch, and many other labourers in the region of original research. They have explored and discovered, and it for us to profit by the lessons which their discoveries teach. When we come to administrative measures, to the vital question how knowledge should be translated into action, and applied so as to relieve the immense mass of human suffering that is caused by malaria—here again we are not without much instructive experience. The problem is not a new one. Malaria is one of the oldest of Indian diseases. The medical hymns of the Atharva Veda, so ancient that they propound a treatment by means of charms and sympathetic magic, contain an accurate description of the symptoms of the disease in which the various forms of intermission are distinguished, and the characteristic accompaniment of jaundice, especially during the rainy season, is carefully noted. Several centuries later the Ayurveda designates malaria as the “king of diseases” and prescribes less primitive remedies. Better evidence of antiquity would be hard to find. Through all these ages men have been endeavouring, by such means as they could devise, ranging from the magic of the Atharva Veda, down to the microscopes and cultures of our own time, to discover the causes of the disease and the methods of avoidance and cure. And I think some recognition is due to these forgotten workers. They were hampered by erroneous theories; they had none of the scientific technique that is now available; nevertheless they did good service in their day, and they arrived by empirical paths at various practical conclusions which we cannot afford to despise.

We have now come to the end of our deliberations. Some interesting and valuable papers have been read; all aspects of the question have, I think, been very thoroughly discussed; and I am not without hope that our conclusions may form a useful basis for further action both as regards scientific research and administrative measures. We do not pretend to have said the last word on the subject. Scientific enquiry must continue, and for this we suggest an organization which will secure that all new ideas shall be fully examined and discussed by competent authorities. As to executive action, we recommend that this should be directed to the extirpation of mosquitoes, wherever this is found to be reasonably practicable, and to the promotion of the use of quinine. We have endeavoured to indicate the lines that should be followed in each case. In the course of our discussion we have profited greatly by the presence of Indian gentlemen representing various provinces, and I desire to take this opportunity of acknowledging their services and thanking them for the valuable advice they have given us. This has led me to consider how co-operation such as we have received from them can be secured, in an organised fashion and on a much larger scale, for the measures that all of us have at heart. I am sure you will agree with me that it is out of the question that even the comparatively modest and tentative operations that we recommend should be carried out effectively by any official machinery that it is possible to contemplate. Even if we had, as I hope we may have some day, a complete sanitary service, or rather a graduated series of sanitary services—trained sanitarians, trained engineers, trained inspectors, most, if not all of them, Indians—we should still be unable to touch more than the fringe of the subject. In the first place, the cost of an official agency that should carry sanitation into the small towns and villages of India is bound to be prohibitive. I need not dwell upon that difficulty. Secondly, every rupee spent on establishments means a rupee less for the preventive and curative measures which are the real essentials. Thirdly, and this is perhaps the most important point, any operations that will make an appreciable impression on malaria—drainage, clearing jungle, removing puddles, filling tanks, administering quinine, whatever they may be—involve a degree of interference with the daily life of the people, their domestic affairs, their interests, their prejudices, and their superstitions, that no official agency can embark upon without incurring the gravest risks. The first condition of success is that the people must help us, for only by helping us can they help themselves. Are they capable of doing this at present? I think not; they must be taught; we look to their natural leaders to teach them; and I am confident that we shall not look in vain. It is almost an impertinence on my part to submit to the Indian members of this Conference a sketch—a very rough sketch—of the sort of organisation that perhaps might deserve their consideration. But what occurs to me is that, when the new Legislative Councils are constituted, the non-official members might take in hand the question of malaria. There will be in every province members representing territorial areas, divisions, sub-provinces, or groups of districts. I suggest that in each such area the member should form, and should himself preside

over, a committee including all the leading men,—landholders, bankers, merchants, lawyers, professors and schoolmasters, journalists, doctors, in short, every one of influence—and that they should initiate and carry on a systematic campaign against malaria. For each district there would be a similar committee, its president being a prominent municipal commissioner or an active member of the district board. They in their turn would see to the formation of committees in sub-divisions, tahsils, taluks, whatever the local unit may be, and we may hope that in course of time the organisation will be brought down, if not to the village, at any rate to groups of villages. If you ask what should they do, I would answer what could they not do? They would be in the closest touch with all ranks of the people; they could teach; they could persuade; they could do all the things that an official agency would attempt in vain. They would induce men of means to re-excavate the tanks which the piety of an earlier generation constructed; they would remind the absentee of his obligations to his ancestral village; they would initiate minor schemes of drainage; they would organise private charity for the provision of quinine, and above all, they would bring home to the people that there are many simple measures which tend to avert malaria, and that their only chance of escaping the disease is to carry out these measures for themselves. In such propagandism the public spirit of Indian journalists would find unlimited scope. That is a rough outline of the lines on which the committees might work. The difficulties in front of them are obvious; but I can see no other way in which they can be surmounted; and I am confident that the Indian members of this Conference will agree with me in regarding the question as one of the highest national importance.

The President then read the provisional conclusions arrived at as a result of the discussions on the previous days and invited suggestions.

The following discussion ensued:—

In regard to investigation of the epidemiology of malaria.

Colonel Thornhill observed that they had not got the full history of any of the malaria bearing mosquitoes, nothing was known of their habits, where they hibernated, &c., and he thought it was important to get these particulars.

In regard to the question of vital statistics.

Colonel Dyson said that in Bombay the village was the unit and not the *thana*.

Major Rogers said that in Bengal the figures for villages were all combined together in the *thana*; they should be sent in separately to the Sanitary Commissioner's office, where they would be available for enquiries such as Captain Christophers had carried out.

The President thought that the Conference might record that the *thana* was considered to be too large an area for the purpose and might suggest that smaller units should be made use of.

Captain Christophers observed that there would be great difficulty in going lower than the *thana*.

Colonel King said that in Madras the unit was a population of 5,000, and that in cases of large numbers the figures were grouped.

Mr. Fox-Strangways remarked that in the Central Provinces the village statistics were recorded in the *thana*.

Mr. Maude stated that in Bengal there were no statistics in the village, they were recorded at the *thana*.

Mr. Ferard said that in the United Provinces figures were given to the Sanitary Commissioner's Department according to sanitary circles.

The President suggested that local Governments might be asked to consider the question of recording their vital statistics by such local groups as would best illustrate the distribution of malaria. Some natural grouping was required.

In regard to the Agency by which investigations should be made.

The President said that as regards the appointment of officers to carry out investigations sometimes the Central Committee or the Government of India would do this on their own initiative. Suppose again it was generally agreed that an enquiry into the prevalence of malaria was to be held in a particular part of Madras, the local Government might point out that they had a competent officer whom they proposed to employ. In that case there would be no objection to his employment. If on the other hand no suitable officer was available locally, one would be sent. Investigators employed in a province would work in accordance with methods laid down by the Central Committee. Local organisations would correspond direct with the Central Committee but would in no way be under the orders of that body.

Major Wilkinson maintained that the local organisation was not required.

Some discussion arose on the question whether in connection with a local organisation the Sanitary Board should be specifically mentioned. *Mr. Fox-Strangways* thought the omission of mention of it would lead to the conclusion that the Sanitary Board was not a suitable local organisation.

Colonel King did not think that the officer who would be deputed by the Government of India should be deputed except at the request of the Local Government.

Mr. Nathan thought this was sound. He then proceeded to refer to the question of the appointment of a special officer under the Sanitary Commissioner of the province. It was necessary to appoint one who would remain long enough to know the province thoroughly. He thought the Central Committee should not send officers to carry out investigations apart from the schemes of the local Government. They should consult the local Government. It should be a provincial organisation with the Deputy Sanitary Commissioner at its head, and the provincial organisation should seek and utilise the services of the Central Committee.

Colonel Leslie pointed out that that was precisely the aim of the scheme.

The President put the case of a new discovery with regard to malaria being made in Europe. If the Central Committee desired to have the question investigated and the area in which that could be best done was situated in some province, could not the Committee send the officer without the permission of the local Government?

Mr. Nathan replied that that would be a special case. If special circumstances arose it would be for the Government of India to issue instructions.

Sir H. Stuart said the officer would not be under the orders of the local Government. The whole of India was not to be shut against scientific investigation.

Mr. Nathan saw no objection in a special case of the kind, but he thought the control of anti-malarial operations in each province should be in the hands of a special officer subordinate to the Sanitary Commissioner of the province.

Major Rogers said it was most essential that the officer should be permanent and under the local Government. At the same time they would be only too glad to have the aid of any additional officers sent by the Government of India.

Mr. Nathan pointed out that the provincial officer would, under the Sanitary Commissioner, conduct the preliminary statistical enquiry, select the special localities for investigation and operations and supervise these investigations and operations. This would not preclude the Government of India sending a special officer for its own scientific investigations.

Mr. Weir said that although the evil of malaria was not a crying one in the Madras Presidency still they would be glad to have a special officer.

Major Rogers said that the question was of the greatest importance in Bengal and it was essential to have a permanent man.

Colonel Bate said that the Punjab would be very glad to have a special officer. The officer should be attached permanently for the purpose of investigating malarial diseases.

Mr. Fox-Strangways said the Central Provinces would also be glad to have a special officer.

Mr. Cholmeley did not think there would be any objection in Burma. The special officer might be a member of the Sanitary Board.

Colonel King thought that where the local officer found himself in difficulties, the local Government would doubtless apply for an Imperial officer.

Mr. Ferard agreed entirely as to the necessity of a special officer. In the United Provinces sanction had been given to the appointment for two years of an officer on lines similar to those under discussion.

Colonel Dyson agreed that such an officer was much wanted.

In regard to Practical measures. The-Extirpation of mosquitoes.

Sir H. Stuart said it had been urged against the Conference that it was being run entirely in the interests of quinine prophylaxis. He thought the Conference should explain that they were by no means prejudiced in favour of one form of remedial measure rather than another. The extirpation of the mosquito was undoubtedly the best remedy that could be adopted for getting rid of malaria and the Conference should make it clear that in some parts of India they recommended resort to the less satisfactory method of quinine because they were forced to do so by the local circumstances. He was amazed at the quantity of quinine that would be required for either the prophylaxis or curative treatment. For 100,000,000 people they would require three times the entire world's production. Moreover, if the demand increased even by half a million pounds the price would go up and increase the financial difficulties.

In regard to the resolution dealing with measures in urban areas.

The President explained that it was not intended to compel every small town to provide an expensive system of surface drainage if there was no reason to suppose that the drains were the breeding places of mosquitoes. But in places there were badly aligned surface drains with puddles and deep hollows, and these were breeding grounds; it was in such places that proper surface drainage might be gone in for, if money were forthcoming.

In regard to the resolution dealing with measures in rural areas

The President happened to know that in a certain district in the south of Bengal they had a very ancient, elaborate, and effective system of village drainage. There were hundreds of miles of embankments and the result was that they got accumulations of water. Subsidiary to the rivers and large drainage channels there was a regular system of drains. Once upon a time these were effective but had now silted up. These were the sort of cases that the resolution was directed to.

In regard to the resolution dealing with the lowering of a high subsoil water level.

The President said that the Conference would not recommend the expenditure of large sums of money on drainage schemes of doubtful utility, but every scheme should be considered on its merits. Before it is undertaken there should be reasonable evidence that the construction of the work would result in the abolition of the breeding of the anopheles mosquito. He went on to describe the position in Nadia, Jessore, Murshidabad, and other parts of Bengal where there had been a complete change in the lines of drainage. Wild schemes had been put forward as to what might be done with immense sums of money to restore the original condition of the district. These were hopelessly impracticable and he thought it would be well if the Conference were quite clear on the point. At the same time they were not precluded from recommending smaller schemes. It was conceivable that in Jessore they might by a cutting restore a dead river into a live one at a reasonable cost; this was to be recommended in place of the gigantic proposals suggested by irresponsible advisers. It was to be hoped that the result of the scheme undertaken in the 24 Parganas under the Drainage Act would be watched before any similar scheme was put in hand.

Major Rogers briefly explained the scheme and said that no other was in contemplation.

Colonel Bate said that in the Punjab very extensive tracts had been drained with great benefit to the people, and so far as he was aware, there was hardly any desire on the part of the people greater than one to be relieved from the suffering inflicted by imperfect drainage. Mr. Jacob had explained what had been done along the Western Jumna Canal, and he (the speaker) could speak from personal observation of the results attained in other parts. As the result of drainage in Sirsa the health of the people had improved and they had been enriched by being able to utilise land that was formerly valueless. He believed that a resolution was passed during the Viceroyalty of Lord Dufferin that local Governments should undertake drainage schemes. It was said by the Government of India that there was no way in which the funds available for sanitation works could be better expended. Personally he

was of opinion that there was no measure better calculated to relieve the people of the existing evil than drainage.

The President asked if it was not the case that in Karnal and Rohtak waterlogging had been produced by artificial means.

Mr. King said that that was not the case in Sirsa.

Colonel Bate said that waterlogging along the Western Jumna Canal was due to percolation from the channel; the alignment was bad. An attempt was made in each case to find out if the defect was remediable. Each case must, as the President had remarked, be treated on its own merits. The matter should be left entirely to local Governments, and they might be trusted not to embark on impracticable schemes, but they should not receive any sort of discouragement. He had an intimate knowledge of the configuration of many parts of the Punjab, and he would say that there were vast areas where the country could be thoroughly drained and the health of the people improved. In many places the schemes could be made remunerative and the land made productive. He would go so far as to say that in a large number of cases the cost of the drainage schemes could be defrayed from the sale of land that would be cultivated afterwards.

Mr. Nathan was satisfied with the resolution that had been read out by the President. Great caution would be required because of the cost of such undertakings.

Colonel King agreed with the remarks made on the subject of drainage. He especially agreed with Colonel Bate's remarks that there had been neglect of the question of the benefit to agriculture that might accrue from drainage operations. So he had very little to add to the resolution except to ask that some modification might be made in the wording of the sentence relating to subsoil drainage. He hoped that it would be understood that he was not an advocate for rash declarations that drainage and nothing but drainage was necessary. He was aware that finance had limits. In his opinion for permanently getting rid of the anopheles there was no measure that could equal that relating to the drainage of surface and subsoil water.

Mr. Ferard mentioned that there were certain places just below Kosi about the most malarious in the United Provinces where there were numerous tanks. These were drained two or three years ago. There was no doubt that when a municipality or district board carried out a drainage scheme it required the very best expert advice. Such advice could be obtained only from the expert engineers of the local Government, and at present the local Government had the right of charging a certain commission for the loan of an officer's services. He thought it might be mentioned that these services should be given free considering the value of drainage in malaria.

Mr. Lawrence said that parts of Bombay were waterlogged, and this was induced by canals having obstructed the natural lines of drainage. This should be avoided in future.

In regard to the prohibition of wet cultivation.

Mr. Weir said that wet cultivation was shown not to be the cause of malaria in many places. In Madras houses occupied by Europeans were surrounded by rice cultivation, and this caused no malaria. In the Godavari and Kistna deltas the same thing occurred.

Mr. Narayanamurti agreed that in the parts with which he was acquainted there was no connection between wet cultivation and malaria.

Mr. Goswami desired to add something to the effect that where it was established that malaria in a town was due to anopheles breeding in wet cultivation in the immediate vicinity of the town the cultivation should be restricted and prohibited whenever possible. He could not claim to be an authority on the question, but in view of what had been said during the discussion he felt bound to put forward this proposal. Local authorities should have the power to frame byelaws in the matter.

Colonel Bate, Mr. Nathan and Mr. Fox-Strangways supported the proposal.

In regard to the clearance of jungle and the thinning of trees.

Mr. Ferard gave an instance of a town surrounded by trees where the ventilation was much impeded. This was said to be a place where mosquitoes bred in numbers. Legislation was being framed for dealing with excessive tree growth. At present

they had power only to deal with undergrowth; sanitary experts said that pools of water formed at the foot of trees.

Major James observed that to give the impeding of ventilation as a reason for recommending the thinning of trees would be unfortunate, because malaria is not caused by lack of ventilation. The presence of trees led to a lowering of the subsoil water and a belt of trees between breeding places and habitations might be of great service. It would be a pity if the Conference made a recommendation which might discourage the planting of trees near towns and cantonments especially in the drier parts of the country.

In regard to the measure of Oiling.

Major Rogers said that after considerable experience he did not think the plan was any good. The treatment with petroleum should be restricted to small collections of water which contained the larvæ of the anopheles mosquito and could not be filled up. Wells should not be treated with petroleum but should be covered wherever this was possible.

Mr. Sundar Lal and several of the other Indian delegates thought it would be better not to interfere with the wells.

Colonel Bate said that in Khartum great benefit was derived from covering up wells. The results were contained in a review written on the subject by Dr. Balfour.

In regard to the recommendation dealing with Fish.

Mr. Weir thought the idea put forward in the draft resolution, was a very good one. In Southern India the paddy fields swarmed with little fish.

In reply to the President all the delegates said that they were prepared to accept the proposal.

In regard to the resolutions dealing with quinine treatment and prophylaxis.

Mr. Lawrence thought that cinchona plantations should be increased; at present there was a danger of shortage.

In regard to the resolutions dealing with education.

Mr. Narayanamurti was very strongly in favour of the resolution of this subject. In connection with small-pox and vaccination all scholars were required to pass an examination on the points laid down in the text book and the mosquito malaria theory should be also included in the text book. He had himself only recently learnt this theory and as even educated persons were in ignorance of it, it was most necessary that knowledge on the point should be disseminated as widely as possible.

Mr. Goswami said he was in favour of the resolution. He would also add that sanitation and hygiene of an elementary character should be taught in boys' and girls' schools. Leaflets should be distributed.

Major Rogers said that elementary hygiene was being taught in schools in Bengal.

Colonel King said that there was no more powerful method of educating the people than for them to be in contact with Sanitary Inspectors, men who understood sanitation and who were of such high caste that they mingled with the people without any fear of contamination. He gave figures of cost which he had worked out. He moved that the Conference should record the opinion that both in rural and urban areas it is essential that the control of all routine anti-malarial measures should be in the hands of the permanent staff—a constituted organised sanitary service. He considered that special sanitary measures could not be dissociated from ordinary methods.

The President suggested that the matter might come under Finance.

Mr. Ferard thought the important point was to invite the co-operation of private medical men in the campaign.

Colonel Lukis said that this was being done in Bengal.

The President agreed that it was very necessary.

Mr. Mudholkar attached great importance to the issue of pamphlets and leaflets written in simple English on the subject of hygiene and all the matters that had

come before this Conference. These could be translated and issued also. The people had been asked to come to the aid of Government; he believed that they would heartily respond to the efforts that Government was making.

Mr. Nathan thought that in the case of children it would be for the Department of Public Education to arrange for them to be taught such lessons as village sanitation and the like.

Colonel Dyson said that in Bombay there was a sanitary primer but the teaching had largely failed because there was no guarantee that the teachers understood what they had to teach.

Mr. Mudholkar said that he attached great importance to the association of the educated classes in this great work of mercy upon which the Government were engaged. Reference had been made to uncharitable criticism. He said it was a matter of humiliation to them, and he would ask Government not to pay any heed to such criticism.

Mr. Narayanamurti quite agreed with the last speaker. He was sure that Government which was always so solicitous of the welfare of the people would spare no expense in the carrying out of these measures. There should be in all the work suggested the hearty co-operation of the educated people, with the Government in their benign efforts.

Mr. Goswami said he was in entire sympathy with the resolution. In recent times the tendency was for Government to associate officials with non-officials in any undertaking where this was possible. This association always led to great good. In the case of combat with malaria some of the liberties of the people might have to be restricted and regulations would have to be passed, and this association was therefore the more necessary, and it would come to the people as having the sanction of those who belonged to them.

In regard to the resolution dealing with the Sanitary Staff.

Colonel King moved his proposal on the subject of the *control of routine anti-malarial measures*. He wished it to be understood that the executive grades of such a service would be under the local authorities.

Mr. Cholmeley was in entire agreement with the proposal.

Mr. Sundar Lal was also in agreement. He explained that at a Conference last year in the United Provinces a similar resolution was passed; the suggestion was that there should be an Assistant Surgeon who was to help the Civil Surgeon, with Inspectors wherever necessary.

Mr. Maude said that the appointment of Inspectors was made compulsory on District Boards in Bengal. The enquiries of the Local Government were not as yet quite complete but the opinions received seemed to point to the recruitment of men of the class of Assistant Surgeons.

Sir H. Stuart said that the Sanitary Inspector was the creation of the Madras Government. He was not allowed to go to rural areas as it was thought he might become another agent of oppression. The Government of India lately addressed local Governments on the subject of a sanitary service, and they especially refrained from raising this question of a Sanitary Staff in rural areas as it was believed that there would be strong objections on the part of the people.

Mr. Nathan agreed with Sir H. Stuart, and he thought that Colonel King's proposal would carry them to dangerous lengths. Possibly some increase in the superior inspecting staff would be called for. As regards towns it seemed unnecessary to pass any resolution; the increase of the organisation of a sanitary staff was already under consideration. As regards rural areas an officer was needed in special localities selected for experimental operations. As regards districts the most that was required seemed to be the appointment of an Assistant Surgeon for supervision under the Civil Surgeon of the District.

Colonel King said with reference to Sir H. Stuart's remarks that the whole question of money dealing was gone into by the Madras Government, and it was concluded that in no case had the men departed from sound moral conduct. He claimed that his scheme was an economical one, and that in addition registration duties could be performed.

After some further conversation and some alteration in the working of the resolution with a view to putting it in more general terms, Colonel King said that as finally drafted it would cover his point.

In regard to the resolution dealing with Finance.

Sir H. Stuart said that it seemed to him that the case was almost entirely one for local taxation. The disease was local, the results of it, economic and otherwise, were local, and the benefits of prevention and cure would be local. This was essentially a case therefore where the financial burden of the proposed measures should be local. He thought if it was brought home to the ryot that the funds raised from an additional cess were to be devoted to relieving him of a grievous burden he would agree to bear it. He had accepted other taxes of a similar nature, such as the cess for construction of local railways although the benefits in that case were only indirect as a rule.

Colonel King held that malaria was very far from being only a local danger. Mosquitoes carried the germ far and wide, and in the case of emigration of coolies the disease was carried to various centres. Again, he regarded the whole of the infected area not as one where further taxes should be levied but rather one where provincial funds should be contributed.

Mr. Narayanamurti said the ryot would not believe that he could get any benefit from a cess, and would consider the imposition of additional taxation as a great hardship. As regards the railway cess he got back the money.

Mr. Goswami said that there was no railway cess in Bengal.

Mr. Narayanamurti said that perhaps the educated classes might agree to it, and in towns and municipalities he did not think there would be much opposition, but the ryots who lived in great poverty in malarial tracts would consider it a great burden.

Mr. Goswami gave some particulars of the cesses at present levied in Bengal; he thought that District Boards in Bengal, unlike those in other provinces did not get the full benefit of the local cess that was realised from ryots and landlords. The road cess had been earmarked for the purpose of improving means of communication and for water supply. If the Public Works cess were localised and made available for district boards it is certain that a great number of sanitary improvements could be effected. He held that poverty was accountable for malaria, poverty reduced the people's power of resistance, and if further taxation was to be imposed then that resistance would be further reduced. He went into some detail as to the high holding tax, the latrine and the water tax, and stated that if an addition was to be made to all these taxes it would be felt to be a great burden.

Mr. Mudholkar opposed an additional cess on the same grounds as those advanced by *Mr. Goswami*. There was an additional objection, namely, that all the feelings of gratitude in the minds of the people would vanish. The district boards were at the end of their finances, and the same was the case with municipalities. They would have to find funds to improve the water supply and drainage, and fresh taxation on this account would be necessary; if therefore a malaria cess were imposed it would be considered a great hardship. Money should come from provincial and Imperial funds.

Mr. Sunder Lal explained in detail the method of taxation prevailing in the United Provinces, and concluded by saying that he felt that funds for the proposed measures should come from provincial revenues.

Mr. Lawrence saw no objection to the plan provided it was only permissive.

Sir H. Stuart said he would not press his suggestion against the views of the Indian members.

Colonel King moved that for the correct investigation of drainage measure directed against malaria it was essential in each province that the officer undertaking the investigations should have the aid of an expert drainage engineer with an adequate staff.

The President saw only financial objections to the proposal. On the motion being put to the vote it was lost, the voting being for—9; against—16.

The President: Gentlemen, it only now remains for me to thank you for the time and trouble you have devoted to this question, and to express the hope that the Proceedings of this Conference will bear fruit in the future, and be taken seriously, and above all that we may get the very considerable sums of money that our proposals will demand. The Conference is now closed.

RESOLUTIONS AND RECOMMENDATIONS.

I.—Scientific Investigations.

1. That the Conference is much impressed with the need of further knowledge of the following subjects and recommends that steps be taken without delay for their systematic investigation:—

- (1) The distribution of malaria.
- (2) The epidemiology and endemiology of malaria including (a) meteorological and physiographical conditions, and (b) the life history of malaria-bearing mosquitoes.
- (3) The physiological and therapeutical action of quinine and other remedies for malaria.

2. A critical examination of the vital statistics of each province should be undertaken with the object of ascertaining the different degrees of prevalence of malaria and the areas which may be regarded as typical for the purpose of further test and investigation. In this connection the Conference invites attention to the researches conducted by Captain Christophers in the Punjab.

3. Vital statistics are now collected by villages and are compiled by areas such as *thanas* and *taluks*, which are often so large as to obscure the true distribution of malaria. The Conference are of opinion that local Governments should provide for compilation by some smaller units, such as villages, village unions, *zails*, *patwari's* circles, &c.

The figures thus compiled need not be published but should be kept on record at convenient centres.

4. The Conference considers that the existing vital statistics of provinces will throw much light on the distribution and relative prevalence of malaria if the figures for fever are corrected by the results of test enquiries in selected typical areas. Such test enquiries should be carried out in every province by a special staff under careful supervision.

5. Where investigations into the epidemiology and endemiology are undertaken, special attention should be paid to tracts in which malaria is not endemic with the object of discovering the reasons why such localities are free from the disease.

II.—Agency by which Investigations should be made.

1. The Conference having learnt that the Government of India will appoint a Central Scientific Committee to direct and co-ordinate investigations, and that they will also appoint at the request of local Governments or on the recommendation of the Central Committee officers to carry out investigations, recommends that a local organization to work in consultation with this Central Committee be constituted in each province. The nature of such organization should be settled by the local Government and may take the form of the Sanitary Board.

2. A Conference consisting of the members of the Central Committee and a delegate from each local organization should be held annually at such place as may be convenient for the purpose of reviewing the work done and preparing a programme of future work.

*III.—Practical Measures.**A.—Extirpation of mosquitoes.*

1. As the extirpation of the anopheles mosquito is obviously the most complete and satisfactory solution of the malaria problem, the Conference recommends that investigations be continuously carried on with the object of ascertaining by what methods this can best be done at a cost which is not prohibitive.

2. The Conference makes the following recommendations regarding the

measures for extirpation or reduction of mosquitoes which have been placed before them:—

1. *Drainage:*

- (a) In urban areas where the existing surface drains are found to be the chief breeding place of anopheles mosquitoes, a properly graded surface drainage is a most important anti-malarial measure.
- (b) Though in rural areas the construction of any system of masonry drains is impracticable on account of the cost, yet it is advisable to improve the surface drainage in malarious localities by removing obstructions and filling up depressions in which water stands and anopheles mosquitoes are known to breed.
- (c) Both in villages and towns the lowering of a high subsoil water level when practicable is an anti-malarial measure of primary importance.

The deliberations of the Conference have shown that it will not be possible to protect rural areas by any scheme of drainage which is financially practicable, but it has been found that in some highly malarious tracts the level of subsoil water has been materially lowered with great permanent benefit by drainage operations, the cost of which was not prohibitive. Similar schemes should be investigated in each province for highly malarious localities.

- (d) The Conference is unable to make any general recommendation regarding the prohibition of wet cultivation in close proximity to dwelling houses, for while there is evidence of good results having been obtained by that measure in some localities, there is also clear evidence that malaria is in no way a necessary consequence of irrigating land near towns and villages. Every case of the kind requires separate investigation.

When it is established that malaria in a town is due to anopheles mosquitoes breeding in wet cultivation in the immediate vicinity, such cultivation should be prohibited or restricted whenever possible.

- (e) In Italy some success has been attained in filling up marshes by turning rivers on to them and thus reclaiming them by successive deposits of silt, and the Conference draws attention to this method.
- (f) The clearance of jungle and the thinning of over dense tree growth are desirable in all places in the neighbourhood of habitations where these conditions impede drainage and shelter mosquitoes.

2. *Oiling.*—Treatment with petroleum should be restricted to small collections of water which contain the larvæ of anopheles mosquitoes and cannot be filled up, or drained.

3. *Fish.*—It should be ascertained by enquiry and experiment whether the breeding of anopheles mosquitoes is greatly checked by the presence of fish in tanks and other collections of water; and if this is found to be the case, endeavours should be made to introduce suitable fish where their presence is likely to prove beneficial, and to afford protection to them where they exist.

B.—Quinine treatment and prophylaxis.

(1) The Conference adopts the conclusions of the Sub-Committee, whose report is referred to on page 71, regarding the quantity of quinine required (i) for treatment of malaria, and (ii) as a prophylactic.

- (a) Quinine should be given in the form of sulphate or hydrochloride for adults;
- (b) For children some palatable form, such as tannate, is recommended.

(2) Generally speaking, the method of selling quinine by treatments is to be preferred to that of selling by the dose, but in order to meet the wants of the poor it is advisable that both systems should be maintained. It is suggested that the ordinary size of the tablet should be one of five grains, which is the proper prophylactic dose for adults.

(3) The agency for the sale of quinine should not be limited to postmasters, but the services of all grades of officials should be utilized; special attempts should be made to induce private vendors to engage in the business; and the educated

classes should be asked to organize means of spreading a knowledge of quinine among the lower classes. The rate of commission should be liberal.

(4) In order to disseminate a knowledge of quinine as widely as possible, recourse may properly be had to movable camps, itinerant dispensaries, leaflets, notices, and advertisements, especially in the vernacular papers, and to teaching in all grades of schools.

(5) The free distribution of quinine should as a rule be resorted to only in the case of severe epidemics. This rule will be open to exceptions at the option of local Governments, especially in backward tracts where quinine is unknown, and in the case of school children in malarious tracts and during the malaria season for prophylactic purposes, provided that arrangements can be made to secure that the quinine is actually taken.

(6) General measures of quinine prophylaxis, such as the sale of Government quinine by all available agencies and the dissemination of a knowledge of the benefits it confers, should be carried out as widely as possible. More specialized and expensive methods, such as movable camps and the distribution of free quinine to adults and children, should ordinarily be confined to selected areas.

(7) The Conference is informed that the maximum output of the Indian factories is limited to 100,000 lb. of sulphate of quinine, which would be sufficient to treat about 3,000,000 people; and that the world's supply has for some years been stable at £1,000,000, or enough to treat about 30,000,000 of people. These facts have an important bearing on the possibility of treating malaria by quinine. In the event of the supply from the Government factories proving insufficient, it will be necessary to purchase quinine in the open market. In any case the Conference think hydrochloride of quinine should be procured by purchase and should not at present be manufactured in the Government factories.

It is desirable that the area under cinchona should be increased.

C.—Education.

(1) The local organization in each province should frame a scheme for instructing the inhabitants of malarious tracts regarding the main facts connected with malaria. Such instructions should be given by lectures, illustrated if possible by magic lantern slides, and by leaflets, and pamphlets in the vernacular languages. Private medical practitioners should also be invited to disseminate a correct knowledge of the subject.

(2) The Education Department should arrange to include in text-books, lessons on malaria and hygiene, and to give similar instructions in normal schools.

(3) The Conference strongly recommends the constitution of Divisional and District Committees of the nature suggested by Sir Herbert Risley, and of local societies similar to the league started by Mr. King with such success in Gurdaspur. Such Committees and societies should consist of both officials and non-officials.

D.—Sanitary Staff.

It is desirable that the Sanitary Department should be organized with reference not only to general sanitation, but also to the suppression of malaria.

E.—Finance.

(1) Each local Government should be invited to make a special allotment of funds every year for the investigation of the problems connected with malaria and measures of prevention.

(2) The Conference recognize that the amount of this allotment will depend upon the state of the provincial finances, but they would urge that the prevention of malaria has a strong claim upon all surpluses and increases of revenue.

(3) Municipal Councils and local Boards should also be urged to set apart funds for the prevention of malaria.

No. 2.

Presidential Address delivered at the Second Meeting of the General Malaria Committee, held at Bombay on November 16th, 1911, by Surgeon-General C. P. Lukis, M.D., F.R.C.S., Acting Sanitary Commissioner with the Government of India.

My first duty is the very pleasant one of welcoming you to this, our second conference. I trust that our deliberations during the next three days may lead us one step further in the direction of the goal at which we are striving, namely, the mitigation of Malarial Fever in this country. But, before proceeding to the formal business of the day, I must first place on record my sincere regret that, owing to his untimely death, we are deprived of the valuable assistance of my friend and colleague, the late Lieutenant-Colonel Leslie. His loss will be deeply felt not only by us but by all those who are interested in the cause of sanitation in India and the Far East, and I am sure that I am expressing the views of this meeting when I say that we sympathise most sincerely with his family, whose loss is so much greater than ours.

The purpose of the present meeting is to ascertain what progress has been made since we met for the first time in Simla in November last, and to make suggestions which will facilitate further advance.

With this object the agenda paper has been prepared under three chief headings, to which the discussions on each day will be strictly confined.

But, before inviting the delegates to state what has been and is being done in the different provinces, I must ask your indulgence for a short time whilst I draw attention to certain points of general interest. In the first place I wish to ask for your assistance in regard to our publication "Paludism," two numbers of which have been brought out during the last year. I think it will be admitted that "Paludism" is a very useful paper, but, gentlemen, its usefulness will not be maintained unless, in the future, we receive from officers engaged in malarial operations, far more contributions than have been received in the past. The preparation of the third number, which was issued in August last, was particularly difficult on this account; I trust therefore that my present appeal will not be in vain.

Another matter of general interest is the recent change in the method of selecting officers to attend the malaria classes at Amritsar. Under the new arrangements it will be possible for any officer, who is seriously desirous of studying malaria, to gain admission to one of the classes, and it is hoped that ere long this will result in a large number of competent and keenly active workers being spread over the country—a result that cannot fail to bring about a great increase in our knowledge not only of malaria but of other closely allied diseases, especially those of the "Leishmania" group.

Finally, brief reference must be made to the new Indian Research Fund with the aid of which we hope to carry out many investigations which hitherto for financial reasons have been outside the bounds of practical politics. The first enquiry which will be undertaken at the expense of this fund has already been commenced, namely, an enquiry into the methods by which Yellow Fever may be prevented from entering our Indian ports, and may be stamped out should it ever succeed in obtaining a footing.

The danger of its introduction which may arise on the opening of the Panama Canal has recently engaged the serious attention of the Government of India, and it has been decided, in consultation with the Right Hon'ble the Secretary of State for India, to depute Major James to the endemic area by way of the route that will be followed by ships proceeding to India when the canal is opened. During his absence his duties as Secretary to this Committee and Editor of "Paludism" will be performed by Captain McKendrick, whose special knowledge of anti-malarial measures renders him especially fitted for the post.

There are two other enquiries in which we expect to obtain the assistance of the Research fund.

The first is the institution of malariometric investigations, for which work the central committee consider it desirable to have at least one worker who can devote his whole time to the development of malariometric methods and their application to the study of Indian malaria. Such a worker we hope to obtain with the assistance of Sir Ronald Ross.

The second is an enquiry into the bionomics of Anopheles, in connection with which we trust that we shall be able to secure the help of Professor Howlett.

So much for investigations to be made in the future. I now turn to two very important contributions to our knowledge which have been made during the past year.

The first is the publication of Dr. Bentley's admirable report on the causes of the recent malarial outbreak in Bombay, which has confirmed Major Liston's original observations incriminating *Neocellia Stephensi* as the carrier of malaria in this city; and which suggests that malaria can not only be reduced, but it can be absolutely eradicated from the greater part of Bombay at a cost which would amount to less than a tenth part of the loss estimated to be occasioned each year by the disease. The second contribution is a report which has just reached me from Major Christophers, who was sent to investigate the causes of malaria in the Andamans. The first thing that struck him was the remarkable fact that a large number of villages were quite free from malaria in spite of the fact that many of them were surrounded by riceland, swamp or jungle, whereas others showed a considerable amount of malaria, the spleen rate varying from 25 per cent. to 50 per cent. Eventually it was noted that what determined the healthiness or unhealthiness of a village was its proximity to the sea. Villages near the sea were invariably malarious; those remote from the sea healthy. Even a distance of half a mile from the sea was sufficient to ensure the endemic index being 0 per cent. This distribution of malaria was shown by actual measurement to be exactly coincident with the occurrence of a particular species of anopheles, namely, *Pseudomyzomyia Ludlowi*, which appears to breed chiefly in salt swamps and brackish water, and which is undoubtedly the chief malaria carrier in the Port Blair Settlement.

Now so closely does this mosquito, on casual examination, resemble *N. Rossi*, that, with reference to these two species, Prof. Eysel has remarked upon the folly of too nice distinctions with regard to the species of anopheles and the transmission of malaria. Yet the existence of two distinct, though closely related, species of anopheles is the explanation why, in the Andamans, the proximity to ricelands and swamps is innocuous, provided that these are at a distance from the sea.

These observations of Bentley and Christophers show, I think, the value of investigation, and how important is the study of species when one is concerned with the spread of malaria by anopheles; but, gentlemen, they do more than this, they justify the hope that the adoption of anti-mosquito measures in India must not prove either such an expensive or impossible task as some would have us believe.

Here I should like to say that I view with concern the tendency amongst malaria workers to divide up into two camps, namely, those who advocate anti-mosquito measures and those who pin their faith on quinine prophylaxis. In this connection I would draw your attention to a speech which I made before the Imperial Malarial Conference in 1909, when, after pointing out the almost insuperable difficulties connected with quinine prophylaxis as applied to a free population, I went on to say that, whilst agreeing that quinine prophylaxis, properly carried out, was one of the most valuable weapons in the fight against malaria, and whilst admitting that in rural areas it might be the only weapon at the disposal of Government, I felt bound to express my opinion that, if they were to place sole reliance on this measure in Indian villages, they were doomed to disappointment. Quinine prophylaxis should go hand in hand with general sanitation and with the destruction of anopheles breeding grounds wherever this can be accomplished at reasonable expense, and it seems to me that recent observations justify us in thinking that this destruction is not likely to be as costly as has hitherto been supposed. Quinine has undoubtedly conferred inestimable benefits upon the individual; but it never has and never will be of equal value to the community as a whole, and you cannot get away from the fact that if there were no mosquitos there could be no malaria. I fully realise that in some of the hyperendemic areas mosquito destruction may be a counsel of perfection, but even there much good may be done by reducing the numbers of the special species which acts as the carrier, and, I ask you, should we halt in our activity because we cannot attain to an ideal perfection? I recognise the fact that no one method will suffice as a general *anti-malarial* measure: I recognise the power of each in its proper place, but I hold strongly that wherever possible *anti-mosquito* measures must be carried out. I also recognise the importance of preliminary investigation, but it must not be carried to extremes; the time has come for definite action on well considered and practical lines.

It must be remembered that there is a limit to the number of men available for carrying out such thorough investigations—also that such investigations occupy much time; so that, before they are completed, the acute situation may have declined and the psychological moment for action may have passed away—not to occur again until the next epidemic. I wish it to be clearly understood, therefore, that I do not think we can depend upon scientific research alone. For this opinion there are two very good reasons.

In the first place I hold that, in many cases, actual operations may with advantage be carried out in conjunction with investigation. Indeed I consider that, in certain instances, the former may be the only method of investigation. We are dealing with a vast complex of factors and the elimination of one or more of these may be the only practical way of solving the problem.

Again from the point of view of the limited resources at our disposal, as compared with the large amount of malaria with which we have to deal, I submit that if we wait until our experts have made a complete investigation of all the problems connected with the epidemiology and endemiology of the disease, there is the danger that India will remain for many years practically untouched. We require then two classes of men—the scientific experts and the practical workers—the former engaged in research and ready to aid the latter when in difficulties—and the latter trained in the taking of spleen indices and in the recognition of the commoner varieties of anopheles. It is not necessary that they should be able to dissect them. Men trained to this extent would be quite capable of mapping out the geography of an epidemic and that of the mosquito breeding places in the neighbourhood of the infected area, and of noting the types of mosquito found therein; and from the data furnished by them it ought not to be difficult to ascertain the actual carrier and to work out a definite scheme of attack.

I trust, gentlemen, that no delegate will think that I wish to imply that nothing has been done in the past. This is very far from my intention: I merely wish to express my opinion that we are perhaps too much inclined to pin our faith entirely on the scientific investigator to the detriment of the practical worker, and my reason for bringing this forcibly to your notice is that we are, at the present moment, fortunately situated as regards malaria. We have narrowly escaped a year of famine, and, owing to the deficient rainfall, we are justified in hoping that, unless circumstances of an unexpected nature arise, we shall not be visited by a severe epidemic of malaria during the coming year. We have, therefore, ample time in which to prepare our plan of campaign.

Only a few words and I have done. I alluded just now to the diseases allied to malaria, especially those of the "Leishmania" type. There are several points in connection with these which require further investigation.

As you are all aware, the genus *Leishmania* at present comprises three species:—

L. Donovanii—the parasite of Kala Azar.

L. tropica—the parasite of oriental sore.

L. infantum—the parasite of infantile splenomegaly in N. Africa.

The points in connection with these, which in my opinion require further investigation, are as follows:—

(1) *The possible antagonism between oriental sore and Kala Azar.*

So far as I am aware, the evidence in favour of this view is chiefly geographical in nature, and it appears to me that we should endeavour to obtain more accurate and scientific evidence on this point, which is one of more than academic interest, for, if the antagonism is proven, there ought to be no difficulty, on the analogy of vaccinia and variola, in utilising our knowledge and in immunising patients against attacks of Kala Azar by inoculating them with the milder disease.

(2) *The rôle of the domestic fly as a carrier of Oriental Sore.*

Both Wenyon, as the result of his work in Baghdad, and Row, in India, regard this insect as the carrier. On the other hand, Patton, as the result of his recent observations in Cambay, is inclined to incriminate the bed bug. Further investigations on this point are clearly necessary.

(3) *The question of the carrier of Kala Azar.*

It is generally supposed, though it is by no means proven, that the bed bug is the carrier in this case. On the other hand Nicolle regards the dog as the reservoir of the parasite which causes the infantile Kala Azar of North Africa, and both he and Basili have proved that the parasite is carried from dog to dog by the dog-flea, and he suggests the possibility that it may be conveyed from dog to man by the same means.

So far as I know, dogs in India have not been found to be infected with *L. Donovanii*, and I believe that all attempts to infect dogs with it have failed, but I submit that a much more extensive examination of dogs in Kala Azar districts in India would seem to be indicated.

Finally, gentlemen, let us not forget the possibility of the importation of Yellow Fever into India. Major James has gone to Panama to study the methods of keeping it out of the country, but that is no reason why we should sit with folded hands waiting for its arrival.

In this connection I invite your attention to the following quotation from the admirable report on the recent outbreak of that disease in West Africa, which was almost the last piece of work done by the late Sir Rubert Boyce, whose untimely death we all deplore.

He says "Much more attention will require to be paid to the *Stegomyia* and to the fevers met with in towns where the *Stegomyia* is the most common mosquito. Medical officers will require to be as alert to the possibility of Yellow Fever as they are in the West Indies or in Central America. Nay more it is essential to ascertain definitely what is the prevailing mosquito of all principal centres of population, and the enquiry might at this stage with advantage be extended to other parts of the tropical empire such as India and the East Indies."

This is sound advice. Think what a difference it might have made if in 1894 we had known as much about the rat-flea and plague as we now know about the *Stegomyia* and Yellow Fever. It behoves us, therefore, to be up and doing. The Central Malaria Committee has not neglected its duty in this respect; we have already more than 42 species of Culicine mosquitos, including six species of *Stegomyia*, in the Museum attached to the Malaria Bureau, and in order to advance the work still further we are bringing up to date the pamphlet of instructions to Collectors, emphasising in it the present necessity for collecting *Stegomyias* and other Culicine mosquitos, and we are making arrangements to distribute it even more widely than is done at present.

I trust that all of you will do your best to help us in this matter. But do not be content merely with a mosquito survey: lose no opportunity of preaching a crusade against the mosquito, both in its sylvan and domestic varieties. The work of Sir Ronald Ross has demonstrated the danger of anopheline as carriers of malaria; we now know that domestic mosquitos of the genus *Stegomyia* may prove an even greater danger in the immediate future. Even though the complete eradication of mosquitos, therefore, may be a counsel of perfection so far as India is concerned, it is our bounden duty, whenever practicable, to endeavour to lessen their numbers and to educate the public in such a way that the efforts of Government may be supplemented by individual endeavour. Unless this be done, it is useless to expect that our campaign against malaria will ever be crowned by success.

No. 3.

Resolutions passed at the Second Meeting of the General Malaria Committee.

The second *Malarial Conference* was held at Bombay on November 16th and 17th, 1911.

The following resolutions were proposed by Surgeon-General Bannerman and carried:—

- I. This Conference is of opinion that researches by experts in the field such as those carried out by Christophers and Bentley, prove the value of preliminary scientific investigation; and seem to point to the probability that anti-mosquito measures may not prove so costly as was at one time feared. (Seconded by Major W. G. Liston, I.M.S.)
- II. The Conference believes that no one measure can be suitable for all the conditions that favour the prevalence of malaria; that quinine prophylaxis applied to a free population is difficult to carry out in the thorough way necessary for success; and that a combination of several measures may be required as local circumstances may indicate. The Conference is of opinion that notwithstanding the difficulties of quinine prophylaxis it cannot be too strongly emphasized that under the peculiar conditions of the Indian populace arrangements for the treatment of quinine of those sick from malaria is a matter of primary importance from the point of view of saving life, of preventing suffering, and of destroying a potent source of infection. (Seconded by Sir David Semple.)

- III. The Conference desires to call the attention of Government to the possibility of danger arising from borrow-pits in the proximity to human habitations, especially when such excavation would result in stagnation of water therein. (Seconded by Colonel R. W. Lyons, I.M.S.)
- IV. The Conference is of opinion that the education of the people is a most important anti-malarial measure and that every effort should be made to secure the co-operation of the public without which there is little hope that the campaign against malaria will ever be crowned with success. They believe that instruction in schools as well as lectures and lantern demonstrations in villages and towns are the best methods of propagandism, and that in this way information is more likely to reach the people than by publication of pamphlets and posters. (Seconded by Sir David Semple.)
- V. The Conference while strongly recommending the prosecution of further research is of opinion that although expert investigation is still necessary, enough is known as to the breeding habits of mosquitoes, etc., to make it frequently possible for trained workers to deal with malaria in an efficient manner. (Seconded by Lieutenant-Colonel T. E. Dyson, I.M.S.)
- VI. In view of the possibility of the importation of Yellow Fever into India, the Conference suggests the advisability of a careful 'Stegomyia' survey and of the education of the public in the matter of destruction of domestic mosquitoes. (Seconded by Sir David Semple.)
- The six resolutions were carried unanimously. The Conference then closed.

No. 4.

THE PROCEEDINGS OF THE FIRST ALL-INDIA SANITARY CONFERENCE HELD AT BOMBAY ON THE 13th AND 14th NOVEMBER, 1911.

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FIRST DAY'S PROCEEDINGS.

The proceedings which were held in the Council Chamber of the Bombay Secretariat opened with the following speech by the President:—

“GENTLEMEN,

“My first duty, and most agreeable I find it, is to welcome you all to this conference, and, in so doing, on behalf of the Government of India to thank the local Governments and Administrations and yourselves for your presence here. The utility of conferences of this kind is now, I think, generally appreciated, and that not only for any conclusions to which they may lead—though these must often be valuable—but also and especially for the opportunities which they present to zealous workers in different parts of India for comparing experience, exchanging ideas, and above all for setting up that energising friction of mind with mind the want of which most men toiling in isolation feel at times as a burden well-nigh intolerable. Nor can it be a disadvantage that we should get to know one another. Holding this opinion, I earnestly hope that this may be the first of a series of conferences to be held as occasion may suggest at convenient centres. I was anxious that our first meeting should be held in Bombay in order that we might perhaps catch some of the spirit of the place, the spirit which has made it the great and beautiful and progressive city that we see to-day.

“The agenda before us open up large questions of research work and hygiene, the two great and complementary divisions into which modern sanitation falls. By research I mean the acquisition of further knowledge of the specific agents of infective disease and by hygiene the preservation of the public health and the remedy of known defects. You will discuss problems of urban sanitation, town-planning, water-supply, drainage and

conservancy ; rural sanitation ; and special sanitation, more particularly epidemic diseases and food-supplies. You will also discuss vital statistics and improvements in their registration ; and various scientific enquiries will be brought before you. I will not attempt to anticipate the course or the conclusions of your discussion, and I will not intervene with more than a few introductory observations,

“ The basis of all sanitary achievement in India must be a knowledge of the people and the conditions under which they live, their prejudices, their ways of life, their social customs, their habits, surroundings and financial means. This was emphasised in the memorandum of Surgeon-General Lukis, to whose knowledge and rare ability my department is greatly indebted, which I laid upon the table at the last meeting of the Imperial Legislative Council. The proposition is really axiomatic. The ardent spirits who may think that sanitary measures possible and effective in the West must be possible and effective in India will flap their wings in vain and set back the cause which claims their laudable enthusiasm. I am far from saying that this must always be so. I believe with all my heart in the slow but sure results of education, the forerunner of sanitation. But we have to deal with facts as they are to-day. And to-day the forefront of a sanitary programme must be (1) a reasoned account of the conditions and circumstances which affect mortality and the increase and decrease of populations and (2) a study of the relative effects of various diseases, of personal environment and of the social and economic conditions in the different parts of the Indian Empire. We have to work out our own sanitary salvation. We have to study the epidemiology and endemiology of our communicable diseases, the so-called “ tropical diseases ”—plague, malaria, cholera, and dysentery—in order that having ascertained the actual sources and modes of conveyance, we may determine scientifically the particular methods requisite for their avoidance, prevention and suppression ; and that we may apply with precision those methods which it is possible and politic to adopt. And we cannot do this without the assistance and co-operation of Indians themselves.

“ In this harnessing of the science of the West to the varying conditions and circumstances of India we must keep our standard high. For many years it has been the constant endeavour of the Government of India to build up a body of scientific workers whose whole duty is investigation. Laboratories have been provided ; specialists have been appointed ; and we now possess in the bacteriological department a band of workers who are second to none in Europe. The names of Sir Ronald Ross and Sir David Semple, not to mention others, are honoured throughout the world. We have as you know a highly skilled body of investigators engaged solely on research work in connection with plague and an even larger body engaged in research work in connection with malaria, in regard to which a conference will now be held over which Surgeon-General Lukis will preside. There still remain, however, numerous sanitary research problems in India, as yet almost untouched. Some of these problems will, I understand, be brought before us by the provincial Sanitary Commissioners and Deputy Sanitary Commissioners.

“ In particular I may mention tuberculosis. Tuberculosis accounts for more than 75,000 deaths per annum in the United Kingdom and the interesting report recently published by Dr. Turner, Health Officer of Bombay, shows that the mortality from this disease in large Indian cities like Calcutta and Bombay is already considerably higher than in Glasgow, Birmingham or Manchester. One of the two chief sources of danger in this disease is milk and butter contaminated with tubercle bacilli. The question of milk-supply is therefore of urgent importance, and I am glad to note that it is one of the subjects for discussion at the present conference. Then again we have to be forearmed against two diseases from which India has fortunately escaped up to the present, namely, sleeping sickness and yellow fever.

“ Two officers of the Indian Medical Service, Captain Greig and Mackie, have at different times been deputed to Africa to work with the Commissions of the Royal Society sent from England to investigate sleeping sickness ; and a monograph on the subject by Captain Mackie is now under preparation. With a view to prevent the importation of the disease into India regulations for the medical inspection of all immigrants from the endemic area have been enforced for several years at the different seaports, and so far as we know, no cases of the disease have escaped detection. These regulations, however, differ considerably in the different local administrations, and one set of rules is now being drawn up for discussion with local Governments. The danger of the introduction of yellow fever has recently engaged the serious attention of the Government of India and Major James, a specially qualified officer, has been deputed to

visit the endemic area travelling by the route that will be followed by ships proceeding to India when the Panama Canal is opened. He will examine ports at which the ships may touch, ascertain the systems of inspection adopted in them, study the methods by which yellow fever is kept out of Panama and Havannah and the way in which the disease can be stamped out when it appears. He will attend any international conference that may be assembled hereafter to consider the subject and he will draw up a comprehensive report which will enable the Government of India to prepare a definite plan of campaign.

"A determined effort is, therefore, being made to combat disease in its origin. Great results may in time be expected from the recently constituted Indian Research Fund which, as you are aware, is to be devoted entirely to the prosecution of investigations in connection with sanitation. The first meeting of the governing body of the fund is fixed for the 15th instant, when it is proposed to elect the scientific advisory board, to constitute the different working committees, and to draw up a preliminary programme of work. The nucleus of the fund is a sum of 5 lakhs of rupees contributed by the Government of India and it is hoped that this sum will be supplemented later on by the liberality of wealthy and public-spirited gentlemen and ladies in India, so that eventually a very extensive campaign of sanitary research may be carried on. I can imagine no more deserving object of charity than the endowment of research designed to relieve the sufferings of humanity.

"In general or prophylactic sanitation, which by improving the environment endeavours to protect the public from the attacks of all communicable diseases, the Sanitary Commissioners and Deputy Sanitary Commissioners will tell us of steady progress and substantial achievement. The Government of India were able to assist provincial revenues last year by a special grant of more than a crore of rupees, of which 50 lakhs went in subvention of the Bombay Improvement Trust. I hope it will soon be possible to introduce schemes for the reorganisation of the sanitary services, which will go far to meet modern sanitary requirements. I would like to bring specially to your notice the good results obtained in Fraser Town, Bangalore, which still continues plague-proof. And I would ask—Is it an impracticable dream to construct a model town or quarter of a town in each province, with good water-supply, efficient drainage, rat-proof and mosquito-proof houses and an adequate sanitary staff as a measure of demonstration and education?"

"Gentlemen, you are the pioneers of a great and vitalising movement. Sanitation as now regarded covers the whole life of a people. The difficulties before you are many. The ignorance and even hostility of the masses of the people are still fundamental obstacles. But a thousand difficulties need not make a single doubt. The more enlightened minds in India have awakened to the importance of sanitation, and the movement in its favour is steadily gaining ground. In India as elsewhere old ideas of politics are yielding to more modern conceptions of social duty. I doubt not that you will go forward with intrepid confidence in the ability of science to create that environment in which alone man's higher aspirations can be fulfilled. Though you may not yourselves see the fruits of them, your labours will assuredly not be in vain."

On the termination of the speech the following resolution, which was proposed by the President and seconded by Surgeon-General Lukis, was unanimously passed by the conference, the members thereof standing in token of respect:—"The members of the All-India Sanitary Conference desire to place on record their deep sense of loss by the death of the late Lieutenant-Colonel Leslie and their appreciation of his services to the cause of sanitation, and they desire that this resolution be communicated to his widow and family with an expression of their respectful sympathy."

The items on the agenda were then discussed in order.

GENERAL SANITATION.

(a) *Urban Sanitation.*

The President referred to the schemes of urban sanitation (Appendix I.) which had been submitted by local Governments in reply to a letter from the Government of India and stated that what the Government of India required was some definite information on which to allot grants for urgent schemes which were pending for want of funds, in the event of money being available as was the case last year. He asked the various provincial delegates to make any remarks in explanation of the information which had already been furnished by local Governments.

Mr. Hutton (Madras) stated that the works mentioned in the list sent by the Madras Government were ready for execution. The Madras City water-supply and drainage scheme would require a subvention of 77½ lakhs and would take about ten years to complete. The projects mentioned in lists I., II., and III. would take between one and three years.

Messrs. Mandy and Belvadi explained that in Bombay only 14 of the schemes detailed in the list were ready and had been approved by the Sanitary Board and 8 were in progress. The entire programme submitted could be executed in ten years. A supplementary note (Appendix 2) was submitted by *Mr. Belvadi*, explaining further the state of schemes in the Bombay Presidency. The Poona scheme had been financed, the municipality raising a loan of 10 lakhs and Government contributing 8 lakhs.

Mr. Williams submitted revised figures for several of the Bengal schemes, and indicated what, in his opinion, was the relative urgency of the projects. Delay was likely to be caused in carrying out many of the schemes, owing to municipalities being unable to provide funds. The Patna scheme for instance would not be undertaken unless it was almost entirely financed by Government. For the Jherria scheme a substantial contribution might be looked for from the mines. The Maniktolla sewerage scheme might be undertaken in connection with the Calcutta Improvement Scheme. All the schemes could be carried through in seven or eight years if funds were forthcoming.

Major Robertson (United Provinces) said there was little to add to the very full details supplied by the local Government. The works could be carried out in three years if funds were available.

The Punjab Sanitary Commissioner (*Lieutenant-Colonel Wilkinson*) mentioned the Lahore sewerage scheme as one of great importance and ready for immediate execution if money could be found. Municipal resources were already strained by the necessity for further expenditure on waterworks. A military contribution of one-half might be expected towards the Sialkot project. The Amritsar anti-malarial projects and the scheme for Palwal in Gurgaon, a small town which could afford no contribution, were very urgent. The Rawalpindi drainage scheme was also urgent and no money was forthcoming locally. The same might be said of the Murree scheme. The drainage of depressions in Gurgaon was referred to as a proposal deserving special consideration. All the projects in the list could be started very shortly, provided funds were available.

In Eastern Bengal, *Colonel Hare* stated that the most important proposals were the Dacca sewerage and drainage schemes. The detailed plans and estimates of the former would be ready by March, and it was proposed to do the work in sections, spending 2½ lakhs yearly. Government, however, would have to provide almost the entire funds necessary. The drainage scheme had not been worked out and several incidental questions had still to be considered. Over 60 lakhs would probably be required, as it was a very large and extremely urgent project. The other schemes mentioned in the local Government's letter could be speedily completed if financial assistance could be provided. Government would have to find one-half of the money for the Chittagong and Silchar schemes, and the whole of the Shillong and Jorhat schemes. The latter was necessitated by the removal of the Civil Station. There was in addition a long list of minor projects on which three lakhs could be spent without difficulty.

Major Lalor said he was not in a position to do more than assure the conference that the projects of sanitation mentioned for Burma in the local Government's proposals were being rapidly pushed forward. Among the most important were the Mandalay water-supply scheme (a project delayed by serious practical difficulties), the Moulmein drainage scheme, which was imperatively demanded for the sanitary improvement of the town, the scheme for the water-supply of Bassein and the Monywa water-supply scheme, which was urgently needed as a permanent safeguard against cholera. So rapidly were schemes for the sanitary improvement of towns being pushed forward that they had not yet reached the stage of pausing to survey results. A year hence further information would be available.

For the Central Provinces *Major Stokes* explained that a Sanitary Engineer had recently been appointed and Government were anxious to push on urban sanitation. The small towns especially were in need of grants-in-aid, it being impossible in their case to raise half the funds by loans.

(b) Congested Areas and Town-planning.

Captain Justice put in a paper (Appendix 3) on the opening of congested areas, with model rules for new town extension sites and buildings. He showed charts indicating

the plan adopted and the type design, and stated that type designs for town extension and for cheap native houses had been drawn up. In reply to enquiries, he said that the experiment had already been introduced in the Ellore, Cocanada, Rajahmundry, and other municipalities. Land was acquired under the Land Acquisition Act, vested in the municipality, and was sold to the occupiers on condition that they built to the satisfaction of the municipal council, at prices varying from 250 to 1,000 rupees per acre. The scheme is financed from the sale of plots, any deficiency being met by the municipality or a Government grant. Rules are issued from the Sanitary Commissioner's office, laying down points for guidance in laying out these plots and in describing buildings to be erected.

The model houses cost 240 to 280 rupees and were built of brick or mud. They were not rat-proof on account of the expense. If made rat-proof their cost would be enhanced to about one thousand rupees. Streets are in parallel lines. The houses are not back to back, each house has a backyard. This ought to be at least double the height of the house. The backyard opens on a conservancy lane 10 feet wide. There was no trouble in getting land taken up.

Mr. Orr thought there was a danger in not providing for open spaces. In Bombay where land had been given out without prescription of open spaces, in time every unit of land became built over, and extension even took place upwards without any regard to the consequent (sometimes very serious) reduction in the standard of light and ventilation in the lower rooms. The Bombay Municipal Bye-Laws have no such provision as there is in the Trust Bye-Laws. The latter provide that not only the house, but *every room* should be sufficiently lighted and ventilated, by prescribing that in front of the lowest room in any house there must be an air space open to the sky and extending from the wall of the room to a horizontal distance equal to at least half the height of the opposite house, so that light may reach the room at an angle of $63\frac{1}{2}^{\circ}$. This is known as the $63\frac{1}{2}$ degree rule and should be enforced in laying out any new town. The Municipal Bye-Laws merely lay down that there must be a certain amount of window space (one-fourth of the area of the extension wall), but if such windows are ventilated only from a narrow passage between two houses there is practically no light or air. A passage of 3 feet may be sufficient between two one-storied buildings, but when the buildings are run up to five stories, is no use whatever. It is also very necessary in dealing with congested areas that power should be taken (1) to declare any *room* unfit for human habitation and to close it, it being not sufficient merely to have power to declare a *house* uninhabitable, and (2) to pull down a house in the centre of a 'congested block' to let in light and air to the surrounding houses, and to recover at least half the cost from the owners of this "bettered" area. This provision exists in the English law.

In the discussion that followed *Major Clemesha* thought that 36 feet did not provide sufficient width for a road in a new suburb. The width should never be less than 50 feet. Other delegates agreed. The inconvenience of right angled instead of diagonal roads was pointed out. *Mr. Orr* insisted that a greater width of road than could be easily maintained should not be metalled.

Mr. Turner read a note on town-planning in Salsette (Appendix 4), and explained the principles by which he had been guided, and the results of his experience. The main point was the adoption of the principle of redistribution, embodied in the German *Lex Adikes*, obviating as far as possible the necessity of raising capital. The entire land within the area to be planned is pooled, and the local authority takes all land required for public purposes, roads, markets, open spaces, &c. The remaining land is then divided into suitable plots and allotted to the original owners. Disturbance is avoided as far as possible by keeping the main portions of the allotted plots in the same position as the original plots. The owner receives back a diminished portion but is compensated by its increased value. If the loss by transfer exceeds any gain, compensation is paid in cash. The expenses incidental to redistribution, and the cost of making roads, &c., are financed by a loan raised on the security of a development tax assessed on owners in proportion to the individual benefits derived from the scheme. The benefit is ascertained by estimating the unearned increment accruing to each holding on completion of the scheme. In a large area a portion only of the tax need be required from owners until works materially benefiting their land are taken in hand. A man wishing to retain his agricultural holding intact could be left out of the scheme, unless the local authority considered that he should come in. Power should be taken to acquire compulsorily any land required for the scheme, but with redistribution it would be very rarely used.

He thought that with a redistribution scheme it would be necessary to take power to make owners come in. It would not be sufficient to bring in a scheme, only if the

majority agreed. If they did not agree, the matter should be referred to the controlling authority, and if he thought it necessary they must come in. Questions of compensation should be kept out of the ordinary courts with an appeal however to the civil courts in cases over a fixed limit of value. Market value would be paid for acquisition, but no compensation for compulsory acquisition. The local authority would decide what land should form the subject of a scheme. *Mr. Turner* circulated three plans showing a section of the Santa Cruz plan, one with all the original holdings, another the original holdings with the proposed rates upon them, and a third the scheme as it will be when completed. A further note by *Mr. Turner* elaborating and explaining the principles of redistribution is printed as Appendix 5.

In the subsequent discussion on this and *Mr. Porter's* note on town-planning (Appendix 6) it appeared that no town-planning scheme properly speaking had been undertaken in any of the provinces.

(c) *Water-supply, Conservancy and Drainage.*

Major Clemesha in introducing his paper (Appendix 7) on the uses and limitations of small models of septic tanks made the following remarks :—

“The essential point in the design of this little installation is the size of the grit chamber. Here I may mention a very interesting incident that happened in Bengal which absolutely proves the contention that a large and properly designed grit chamber is the fundamental point in the design of this latrine. A mill situated in Howrah constructed a latrine for 2,500 users. At first the coolies refused to make use of the latrine and clamoured for the old one. Eventually, as is usually the case, the latrine became very popular so that the mill hands from two separate adjoining mills used the latrines and as a result the number of users went up from 2,500 to 4,500. This was nearly double the number for which the latrine was designed. The Manager of the mill was in great distress because we were constantly reporting badly on the quality of his effluent. There was no available land in the neighbourhood to build a second latrine. As a way out of the difficulty it was decided to try the experiment of constructing another grit chamber only to accommodate the extra 2,000 users. This was carried out. One side of the latrine was led into the original grit chamber, and the other half into the new one. A very great improvement was at once noticed in the effluent. This simple incident shows that, as we have maintained, by far the greater part of the breaking down action in septic tank latrines goes on in the grit chamber.”

Major Lalor referred to the difficulties of night conservancy disposal in Burma and illustrated his argument by reference to certain towns situated in the delta of the Irrawaddy.

He stated that the chief schemes formulated for the sanitary improvement of one of these towns were as follows :—

- (1) In the year 1901 the removal of the mixed liquid and solid excreta in buckets by the aid of a small system of tramways and trucks was suggested, with disposal by trenching at a distance.
- (2) In the year 1905 the same system of removal was suggested with disposal by septic tank treatment in place of trenching, at an estimated cost of Rs.1,45,733.
- (3) Later, the same system of removal was suggested with disposal by trenching in the dry season and mounding in the rains, at an estimated cost of Rs.1,32,931.
- (4) Later, the same system of removal was suggested with disposal by septic tank through the medium of a small sewerage system with three aligned “pail dépôts” from the centre one of which the combined sewage was to be pumped to the tank. Pumping by electric power was suggested on the ground that such power would be more economical since it would be available also for the lighting of the town. It was further pointed out that for effective drainage of the area pumping would in any case have to be resorted to.
- (5) Later, to meet financial exigencies, a system of removal of solid excreta only was suggested, liquid excreta to be dealt with by filtration *in loco* through aerobic filters, solid excreta to be removed by hand cart and disposed of by trenching in the dry season and mounding in the rains.

- (6) Still later, scheme 3 was again put forward with the advice that experiments should be conducted locally with latrines on the separate system outlined in scheme 5, with a view to the gradual introduction of that scheme if found suitable, at an estimated cost of Rs.1,38,210.

In his opinion, this question presented itself :—“ Are septic tank latrines applicable in the circumstances given as the cheapest and most effective means of combined night conservancy removal and disposal, and if so, what would be the initial cost and annual recurring expenditure of the system approximately, for a town of this kind with a population of 10,000 inhabitants ?”

Major Clemesha observed :—“ The problem depends upon the nature of the town. If the houses are scattered many small septic tank latrines would be required. I suggest that a latrine for 200 users per diem would be suitable. Fifty such latrines at a cost of Rs.1,500 each would suffice ; total cost 75,000 rupees. The annual recurring expenditure would be the cost of providing water and this without more detailed knowledge of local circumstances it is impossible for me to calculate. If the town is compact a standard type latrine for 500 users would probably be satisfactory. The total cost of one installation of 20 such latrines at the rate of Rs.4,000 to Rs.5,000 each would be Rs.80,000 to Rs.100,000. The cost of providing water would probably be less than in the former case.

“ Both schemes imply the existence, or the installation, of a gravitation water-supply. Probably the cheapest method, though not the most sanitary, would be to remove the night-soil by hand, to centrally situated dumping tanks.”

In connection with *Mr. Belvadi's* note (Appendix 2) on the progress of municipal water-supply and drainage works in the Bombay Presidency, it was pointed out by *Surgeon-General Lukis* that certain points had been raised (in paragraph 9* of the note) with regard to septic tanks at Poona.

In answer to the points here raised *Major Clemesha* said :—

“ The first point (A) mentioned was ‘ to ascertain the *optimum* period of stay in a septic tank for sewages of various strength.’ ” *Major Clemesha* pointed out that “ it was entirely erroneous to suppose, as was stated further on in the letter, that experiments of this kind had not been undertaken previously in other parts of India. - It was now nearly five years since *Dr. Fowler* started experiments on precisely these lines, and from an enormous bulk of evidence both of models and working installations (of which there are nearly 100 in Bengal alone) it has been found that a 3 days' rest in the tank with a five-gallon dilution gives about the most economical result. It is never contended that a shorter period would not give very fairly satisfactory results but it has been clearly shown in the work published by him that the further the septic tank action goes the quicker is the nitrification action when dealing with a vegetarian sewage. There are so many points in sewage disposal which have been thoroughly investigated that it seems a great pity that practically identically the same work should be repeated in Bombay. I should also like to point out the difficulties of obtaining the various dilution of sewage. It is necessary to provide latrines with a self-registering turnstile in order to do this, and there are several other difficulties in the way which are not easily overcome.

“ (B) ‘ To ascertain if this period can be shortened economically by the use of such means as hydrolytic chambers or macerating tanks or colloidors.’ The septic tank designed in this country contains both the action of hydrolytic and macerating tanks. The constitution of the sewage is such that the solid particles always remain for a considerable length of time in a separate chamber much longer than is ever dreamt of in ordinary countries. As regards using colloidors we have never tested them in this country though it seems probable that these might possess several advantages in a sewage such as is observed in this country.

“ (C) ‘ To find the maximum amount of suspended matter in the tank effluent which can be efficiently dealt with by different forms of filter material without clogging.’ The reason why suspended matter has not been investigated very thoroughly in Bengal work is because the amount of matter in true suspension is comparatively small and very readily settles out as sludge. There is, however, a very large amount of true colloid material which interferes with the action of filters. We have found that the colloid figure is really of greater value in estimating the purity of a sewage for filtration purposes than the amount of suspended matter that it contains. This conclusion has been arrived at from many years work and from a large number of analyses. An effluent which contains large quantities of colloids will give trouble on filters, if they are made of finely graded material. The same effluent might contain very little material in true suspension.

* *Vide* page 142 below.

Therefore the colloid figure is a better gauge of the suitability of the effluent than the amount of suspended matter.

"(D) 'To ascertain the proportion of nitrates in the filtered effluent and the methods of treatment which will give the maximum quantity of nitrates.' This is a subject which certainly might well be investigated because it is admitted that the nitrification process has not been studied in Bengal as thoroughly as the anaerobic state. However, there is a great deal of valuable work in Fowler's report which I am bound to say hardly need be repeated.

"(E) 'To ascertain how far supervision can be dispensed with in small installations.' Under this head we have made in Bengal small models of tanks in municipalities which are to be treated exactly in the same way as the ordinary latrine. This subject will be dealt with in the course of the next paper, which has been written by myself. It may be briefly summed up by the fact that experience shows that, provided the latrines are designed simply of indestructible material, they give very satisfactory result even under very primitive supervision. A complicated latrine will always give trouble.

"There are so many phases of sewage disposal which have not yet been investigated, such as a careful study of the sewage from a town, that it seems a pity to work on the lines suggested. There can be no doubt whatever that in dealing with an artificially manufactured sewage, containing night-soil, urine and water only, a very good deal has been ascertained. We want to know the characteristics of an ordinary sewage as it passes from an Oriental town. It is perfectly obvious that this is a very different problem from those that it is proposed to study in this letter."

Mr. Hutton then put in a paper (Appendix 8) on water-supply and drainage works in the Madras Presidency.

In connection with the construction of galleries, *Major Lalor* and other delegates asked whether it would not be more efficacious to construct wells outside the river bed though near it which could be put down and taken up easily. A gallery once constructed could not be removed.

Major Clemesha thought that galleries were really the finest things for water-supply. The only drawback was that they did not give quite the same quality of water as a lake or reservoir or filter and were liable to pollution in flood time. As a rule the water was quite pure, but differed considerably in bacteriological efficiency.

Mr. Hutton said they were prepared to put their galleries outside the river beds if they found a suitable ground layer of sand.

RURAL SANITATION.

Captain Justice in explaining his paper (Appendix 9) said that his object in writing it was to show the want of progress and lack of interest in rural as compared with urban sanitation. He thought that what the people required was an object lesson and that for this purpose model villages should be established in each district. He said that model types of wells and pumps, of which he produced three type designs, had also been designed by *Mr. Hutton*. These wells could be fitted with pumps and would cost between 1,600 and 1,800 rupees. In the design a leading feature was the provision of drainage. He concluded by asking for suggestions for improving village sanitation.

Lieutenant-Colonel Wilkinson explained the system of granting rewards in the Punjab to selected villages in the Canal Colonies whose inhabitants had shown particular zeal in sanitation. This had stimulated interest though provisions limiting the total grant permissible to each village were not conducive to the permanency of the interest taken. Once the rewards were exhausted they reverted to their old standards. Village sanitation books containing rules for the guidance of inspecting officers were also in use. What he considered essential to any real progress was some form of legislation. He said that there was no Village Sanitation Act in force in the Punjab.

Mr. Porter mentioned that an Act of this description was in force in the United Provinces and provided for simple sanitation and improvement of water-supply. It could be extended to select villages of over 2,000 inhabitants.

Major Clemesha considered that *Captain Justice's* proposals were at present impracticable. They must distinguish between the sanitation of the environment and the sanitation of the individual. For the first they should be 50 or 100 years ahead of the times of the people, *e.g.*, in putting in a good water-supply. Dealing with individual sanitation they came up against a very different proposition. The individual must first be educated to higher sanitary standards and that would take many years.

Legislation would be useless without getting the people to understand its *raison d'être*, and many of the suggestions for conservancy in the Madras paper were quite

impracticable. He would concentrate on (1) improving water-supply, (2) educating the children in the simplest outlines of hygiene. He considered that the Punjab system of rewards was worth imitating elsewhere.

Mr. Orr entirely agreed. He complained that village sanitation books usually contained a mass of impracticable and unfulfilled suggestions. What was really necessary was to see that suggestions were carried out. He thought that the publication of particularly useful notes might be usefully made from time to time. Much had been done in Bombay to improve water-supply in villages.

Colonel Hare pointed to the different local conditions in Eastern Bengal and Assam where the villages covered enormous distances and where each house possessed its own water-supply. In these circumstances a practical scheme of rural sanitation was very difficult. The Sanitary Board last year received an allotment of funds from Government. These were distributed in different localities, the district board, the people and the Sanitary Board each contributing one-third, the people contributing either in the form of money or labour. Maps of districts indicating the nature of the water-supply, where improvements were necessary, were being drawn up.

Major Stokes mentioned that there was a Village Sanitation Act in the Central Provinces governing all villages with over 500 inhabitants. It was doubtful, however, whether the rules framed under the Act had any real effect.

Colonel Dyson laid stress on the necessity for a pure water-supply for villages and thought the Divisional Sanitary Commissioner and Divisional Medical Officer should be a member of the local board and have a voice in the allocation of funds for the improvement of water-supply, and in the selection of sites for wells.

The conference then rose for the day.

SECOND DAY'S PROCEEDINGS.

SPECIAL SANITATION.

(a) Food Supplies.

Colonel Wilkinson in introducing his note (Appendix 10) on the milk supply of large towns in India explained that the salient points which he wished to emphasise were the necessity for excluding cattle from town areas, the exclusion to be enforced by imposing a tax, the provision of sanitary sheds at low rents outside, the direction of further efforts towards securing a purer milk supply, and providing for the examination of samples of milk and milk products, and the necessity for caution in any further restrictive legislative measures, which might cause a rise in prices. In reply to a question he stated that he was not in favour of Pasteurisation before issue by the Strauss method for India.

Dr. Bose said that measures taken in Calcutta had been rendered nugatory by the opposition of the *gwalas*. It was possible under the existing law for the vendor to escape prosecution by notifying that he sold mixed milk. In any case exclusion from municipalities would mean exclusion from supervision.

Colonel Hare advocated a system of licenses of vendors and dairies within municipal areas and thought that the larger towns should have model dairies. If cattle were excluded from town areas, as *Colonel Wilkinson* recommended, municipal control over them would be lost.

Mr. Orr cautioned the conference against excessive reliance on bye-laws which were in many cases too stringent for practical purposes. The Bombay Corporation's proposed bye-laws were so stringent that it was not possible for a man erecting a cattle stable in accordance with their provisions to make a reasonable profit. The existing bye-laws require a space at least $3\frac{1}{2}$ feet wide to be provided for each animal and insist on a margin of 15 feet clear of buildings all round the stable, and it is proposed to raise the $3\frac{1}{2}$ to 5 and the 15 to 50. At present in Bombay owners of milch cattle could only make things pay by disregarding bye-laws, *e.g.*, by keeping many more animals than the full number a stable is licensed for. One man made Rs.1,200 in two months in this way and was then fined Rs.75. Tests of specific gravity also were evaded without much difficulty. They were trying to get cattle under control by providing a big central area which the Improvement Trust was reclaiming. Exclusion of milch cattle from town limits was not possible in a town of the size of Bombay.

Mr. Turner said that much good was being done by private effort and mentioned a society which had been established for the preservation of cattle, the members of

which pledged themselves to purchase milk from these cattle only. Mr. Tata had a scheme for planting Australian bush which is much relished by milch buffaloes and he hoped to run agricultural farms on these lines. Outside Bombay there were many stalls for milch cattle but little supervision and there were many complaints about the absence of train facilities for getting milk conveyed at an early hour to the city.

Major Clemesha thought that large cities such as Bombay and Calcutta, where the difficulties were enormous, should be differentiated in their treatment from smaller towns where the problem was capable of solution. He agreed with *Lieutenant-Colonel Wilkinson* in thinking that cattle could with advantage be excluded from the town area in very many smaller towns and that the levy of a tax was sound. But he was of opinion that real success was impossible without stringent legislation. The fight with the *guala* had got to come.

Colonel Wilkinson in reply said that the difficulties as to loss of municipal control would be met by the provision by municipal agency of cattle sheds outside the area. Municipal supervision would of course continue. He considered that a system of licenses would probably be better than bye-laws, as matters could then be dealt with by executive authority. In Simla few bye-laws were literally observed, though he had noticed a gradual improvement in the supply of milk. Milk cans were sold to cattle owners at less than cost price and other facilities afforded. He was opposed to any general or stringent legislation, both on grounds of policy and on the effect it would have in prices.

(b) *Adulteration of Food and Drugs.*

In reply to a question from the President as to the adequacy of existing municipal legislation on the subject of the adulteration of food and drugs and as to the desirability of its extension, the general opinion was that the question of the adulteration of food was an urgent one and that existing powers were generally inadequate. *Major Ross* considered that the Madras City Act was quite sufficient if enforced, and *Major Robertson* said that the draft Bill before the United Provinces Council would meet all requirements. It was thought that no active steps could be taken till proper standards had been worked out and fixed. The members of the conference also thought that the question of the adulteration of drugs should be investigated. In regard to the form which legislation should take if found necessary, *Surgeon-General Bannerman* considered that an All-India Act might be preferable provided elasticity was permitted to local Governments to adapt it to local conditions. In any case standards should be worked out by Government officers and not local bodies. The existing staff of laboratories should not, however, be utilised for the purpose, but provision would of course have to be made for a body of competent analysts.

REGISTRATION OF VITAL STATISTICS.

Major Kenrick introduced his paper (Appendix 11) on the subject of improvement in the agency for the registration of vital statistics. He pointed out that the employment of *dhais* as a reporting agency raised the important question of their registration.

Colonel Wilkinson, who put in a note on the importance of vital statistics (Appendix 12), said that the question of the creation of a special organisation consisting of Assistant Surgeons or Sub-Assistant Surgeons as divisional inspectors of vaccination and vital statistics in place of promoted vaccinators was under consideration. Information for checking the registration of births was commonly obtained from *dhais*.

Captain Justice stated that in Madras Sanitary Assistants supervised the work, but the local boards found it difficult with their present funds to maintain the staff. It was difficult too to give them a definite programme. Registration is usually attended to by the headman of the village and is not accurate.

Colonel Dyson said that there was no special supervising staff beyond the sanitary and vaccination staff. The difficulty in employing an improved staff was a question of money. He supported *Major Kenrick's* suggestion about employing *dhais*.

Major Clemesha explained that in Bengal registration was supervised by the vaccination staff in the hot weather, but was admittedly performed perfunctorily. He was doubtful if inspection by low-paid and unqualified men was of any real value.

Dr. Bose referred to the reluctance of the people to register births. He was in favour of a Medical Registration Act to check the growth of unqualified medical practitioners.

Colonel Hare referred to a scheme which he had recently drawn up and which was now under the consideration of the local Government. The difficulties in the past had been lack of supervision by the sub-inspectors and the impossibility of getting Magistrates

to take their reports seriously. The Bengal Registration Act gives ample powers if properly applied. Under the proposed scheme each vaccination inspector was to be held personally liable for the proper registration of such occurrences in every compulsory area within his circle. Each area is to be divided into circles of convenient size and the vaccination inspector is to inspect at least one monthly. He is to submit to the Magistrate periodical reports of default on the part of the people, and the Magistrate on his part is to fix a definite day each month for the hearing of cases. The trial will be summary and the result of the case will be at once noted on the sub-inspector's register. If the prosecution is successful the sub-inspector is entitled to a reward of four annas for each case. He thought that some such methods would speedily ensure better and prompter registration.

Major Robertson read a paper (Appendix 13) explaining the system of registration in the United Provinces and suggested an improved scheme for registration in municipalities. He advocated in particular the appointment of special medical officers of the grade of Sub-Assistant Surgeons in municipalities to which purpose a portion of the sanitary grant-in-aid might be devoted.

The general conclusion arrived at was that though on the whole vital statistics were accurately recorded, the subordinate registering staff should at least in towns be medically qualified. It was also agreed that incorrect registration of the cause of death by the present unqualified staff was the chief obstacle to sanitary science.

It was mentioned that the Census Commissioner to the Government of India had suggested in regard to vital statistics that a typical area with a population of about 40,000 should be selected in each province, a special staff employed for a particular period and the results tabulated. This would provide a normal standard to correct provincial figures.

Major Clemesha stated that this had already been done in the Burdwan district in Bengal.

Colonel Hare said that a whole area was being similarly dealt with in the Dacca division in connection with the anti-malarial enquiry.

Major Robertson mentioned that this had been done in 5 or 6 towns in the United Provinces.

Major Clemesha said that the results obtained in Bengal had been distinctly valuable.

SCIENTIFIC ENQUIRIES.

(a) *Standards for Water Analyses.*

In the discussion which followed the reading of *Major Clemesha's* paper on the necessity for a uniform method of water analysis in India or a uniform nomenclature of faecal organisms (Appendix 14), *Captain Patton* referred to Gaertner's views on the value of the coli group as indicators of contamination. He considered that the dangerous character of a water-supply was in direct proportion to the numbers of such bacilli in so far as they were of human origin, for their presence pointed to a recent contamination with faecal matter, and this faecal matter might contain such organisms as those of typhoid and cholera. Gaertner emphasised the need of thorough investigation into the source and history of these organisms, whether they were of human or other origin. No one had yet been able to find a test of this, and until this was done it was useless to carry out elaborate methods of water analyses as a routine measure. *Major Clemesha's* standard was so high that few of the Madras water-supplies maintained its level. He emphasised the necessity of further investigation made to discern some means of differentiating coli of human origin from that of other animals.

Mr. Hutton considered the question of what action should be taken in the case of a water-supply having received an adverse report. In his opinion MacConkey's method was too complex and lengthy, and the time which must elapse before a report could be received was so long, as to seriously diminish its value. He referred to difficulties which he had experienced from receiving variable reports on filtrates. In certain cases the filtered water was more adversely reported on than the unfiltered. The Government of Madras had sanctioned the erection of experimental filter beds. Very few filtrates attained the standard of perfection demanded by MacConkey's method, and he doubted whether large municipal expenditure in this direction was justified. He himself would give further trial to the simpler and shorter method of Houston.

Major Clemesha, in reply, said that analysis was only of use as a guide. If the analysis pointed to contamination, then the state of affairs should be investigated on the spot. There was no test of the source of coli contamination. It was impossible to say whether it was of human or other origin. This was one of the matters which must be

left to direct investigation. He emphasised the importance of MacConkey's method as it was possible to differentiate between recent contamination and contamination of old standing.

(b) *Infantile Mortality.*

Major Robertson read a paper (Appendix 15) on infantile mortality embodying the results of special enquiries made by himself and Captain Graham in 4 different towns. He drew special attention to the fact that malaria was by far the most important direct cause of death, constituting 22·5 of the total mortality and that tetanus and accidents and diseases due to child-birth came fourth in order of importance.

Colonel Wilkinson referred to the havoc played by malaria and small-pox as causes of infantile mortality. As an attempt to combat it a few lady health visitors had been appointed in Lahore.

Dr. Bose pointed out the apathy of the public and mentioned many contributory causes of death, *e.g.*, injudicious feeding and deficient clothing. He also mentioned the increasing difficulty in procuring milk. The health record in and around Calcutta showed that death from malaria was not an important cause. Scurvy and rickets were very common causes of death.

Colonel Dyson outlined what was being done in Bombay City. They had trained midwives and nurses employed by the municipality and in the last year 60 per cent. of the total number of births had been verified by these midwives. This showed that they were getting at the poorer classes. The chief causes of infantile mortality were debility, diseases of the nervous system, and the spirits evil, the latter being the most common. A very high percentage occurred on the first 30 days after birth. In Bombay it was 34·36 per cent. and in Kanara, a malarious district, as high as 75 per cent. Attention should therefore be chiefly directed to helping mothers in their confinement and teaching them the proper treatment of the new-born. The methods of treating confinements in villages were disastrous. All this showed the necessity for training midwives.

Dr. Rutherford stated that the training of midwives had been taken in hand in Ceylon, certificates being given at the end of one year, but much depended on the willingness of the people to pay for such nurses.

Major Clemesha said there were one or two very marked factors in Calcutta. One was that there was practically no malaria among children, another that tetanus, an entirely preventable disease, was very rife and accounted for 30 per cent. of the total mortality within the first 20 days of life. Another determining factor in Calcutta was the prevalence of premature marriages. Two visiting nurses had been appointed experimentally in Calcutta to assist confinements, while in Burma *Major Lalor* referred to a society for the prevention of infantile mortality having been established, which distributed pamphlets, held baby shows and awarded prizes.

(c) *Plague.*

In introducing the discussion *Major Glen Liston* said :—

"I must presume that you have all read our pamphlet on recent researches in connection with plague in India (Appendix 16), for I have not time to read it now. I have tried to bring out certain points in the paper on which I think discussion could be developed profitably and I now propose to refer to these points.

"Taking up first our observations on the habits and breeding of rats I desire to draw your attention to the very rapid rate at which rats multiply. Our laboratory experiments show that a single pair of rats can multiply to fifty pairs in the course of a year, and although our field experience does not fully confirm this laboratory estimate we are none the less convinced that because of the very rapid rate at which rats multiply, rat destruction, to be successful, must be very thorough and very persistent. It is for you to consider whether, under these circumstances, a direct attack on the rat population of a place is practicable and likely to be successful. I am inclined to think that greater success will in the end attend measures which aim at the diminution of their food supply and at the removal of their breeding places.

"This line of attack on the rat population of a place, I think, has in this country generally been neglected, but some work which has been carried out in Burma by Captain Brayne must be mentioned as an exception. I understand that he endeavours to have houses kept in a proper state of repair and directs special attention to markets where rats are most plentiful and where they generally find ready access to food supplies. Grain godowns and markets in my opinion should be made rat-proof and should be kept clean by a special inspecting and scavenging staff. Markets as far as possible should be isolated from human dwellings.

"Passing on to our experiments with the breeding of rat fleas I think it is of interest and importance to note that, because of the favourable conditions for flea multiplication, a damp cold weather in this country is more likely to be associated with severe plague epidemics than a dry cold weather. It would be interesting to hear the experience of the members of this conference in this connection.

"I pass on now to refer to our immunity experiments which show that in the course of a series of epidemics of plague a race of rats is evolved which is naturally immune to the disease. These experiments have demonstrated that while at the present time in such plague-stricken cities as Bombay, Poona, Cawnpore and Lucknow a large proportion of the rats are immune to small doses of plague, say one one-hundred thousandth part of a grain of an infected rat's spleen, rats from such plague-free places as Madras, Madura and Raipur readily succumb to such doses. Moreover, the young born of the relatively immune rats caught in plague-stricken cities are almost as immune as their parents although it was possible to be sure that these young rats had never been exposed to infection.

"Young rats born in captivity of parents which were probably highly immune to plague, in that they had survived exposure to severe artificially produced epizootics, were even more resistant to plague than ordinary wild Bombay rats which, we have remarked, are at the present time comparatively immune to small doses of plague. It is thus evident that this immunity is transmitted from parent to offspring.

"This is a comforting discovery, for it assures us that if we wait long enough plague will ultimately disappear from India as it has done in the past. Let us hope, however, that this assurance will not lull us to sleep or cause us to curtail in any way our efforts to save the vast numbers of human lives which must otherwise be sacrificed. While we wait for the plague to disappear it may be very many years hence.

"I need only briefly refer to our observations on chronic or resolving plague which have shown that when a sufficient number of rats are used chronic or resolving lesions may be developed after experimental infection with plague virus.

"A more extended experience of these plague lesions has convinced us that they play little part in the annual recrudescence of the disease.

"I pass on now to our epidemiological enquiries which have shown that plague has been absent from the province of Eastern Bengal and Assam mainly because of the habits of the people inhabiting this province and the structure of their houses. The experience has shown us that plague is not likely to spread where the habits of the people and the structure and arrangement of their houses is such as not to favour rats.

"Our observations in Poona City which now have extended continuously over three years have shown that at the close of an epidemic the rat population of a place is greatly reduced and that thereafter if the conditions are favourable the rats rapidly multiply.

"They have shown also that the number of fleas found on rats has a very definite seasonal variation, a variation which is constant from year to year and corresponds with the climatic variations and with the seasonal variations in the intensity of plague epidemics.

"But the most important fact which has emerged from this enquiry is the part played by the people in introducing infection from infected to healthy areas. For a short period, September 6th to September 20th, arrangements were made to determine the number of persons arriving at Poona station from infected towns and villages. During this time 1,232 persons arrived from known infected places. As soon as it became known that Poona City was infected, the number of persons coming to the city from infected places practically ceased and an exodus from the town itself took place. Moreover, the presence of infection in certain places only came to our knowledge when cases of plague were brought to Poona from them, although arrangements had been made with the authorities for securing as early information as possible on this matter. Our information was often many weeks in advance of that supplied to us by the authorities. The importance of obtaining early information of the outbreak of plague has hardly been sufficiently realised by the Government. A great problem will be solved when some means has been devised for obtaining early information of the outbreak of epidemic disease. This is a matter which, I think, specially deserves the attention of the conference.

"I need hardly add that this information of itself will not be of much value unless plans are well drawn up so that action may be taken at once on receipt of the information. In this connection I would particularly like to draw the attention of the conference to the Madras Plague Manual where the course of action of every administrative officer in a district is clearly laid down so soon as information of the outbreak of plague reaches him.

"What is required in the prevention of epidemic disease is (1) early information to

be followed by (2) immediate and clearly defined action. So far as I am aware much requires to be done in this direction in India.

"Our work in the United Provinces has been mainly devised to explain, if possible, apparent anomalies in the distribution of plague. If the rat flea theory of the propagation of this disease is correct, as I believe it is, it should be possible to explain the anomalies of distribution. If with the aid of this theory we are unable to do so, there is something wanting in our knowledge. By making such investigations we are seeking to perfect our knowledge of this disease.

"The Madras Presidency has been peculiarly fortunate in having escaped plague and our enquiries here have been devised to find out whether this comparative freedom from the disease in the Madras Presidency has been due to good luck or good guidance or whether a little of each is responsible. Incidentally we hope to save the Madras Government a considerable sum of money if we are able to show that, after all, there are some compensations, *viz.*, a freedom from plague—associated with a somewhat hot and uncomfortable climate.

"We have carried out a very exhaustive enquiry into the usefulness or otherwise of anti-plague curative serum. Our results show that up to the present no serum has been made which has any marked effect in curing the plague, but we still hope that better results will be obtained in the future.

"In conclusion I wish to draw your attention to the fact that I think the successful work of the Plague Commission has largely been due to the combination of laboratory work with epidemiological and clinical enquiries. I do not think that sanitary science or curative medicine or for that matter medical research will advance one iota unless there is a combination in the work of these several departments of our profession. I think that up to the present in India there has been too great a tendency for the sanitary, the bacteriological and the clinical departments of our profession to hold aloof from one another. Progress can only be made where we seek to help each other."

In the discussion that followed *Surgeon-General Bannerman* agreed cordially with *Major Glen Liston* that the work of the laboratories must be carried on in close connection with the work of the sanitary services and with hospital work. He mentioned the difficulty at Parel owing to the distance from hospitals of the laboratory.

Captain Justice thought that the passport system of Madras should be maintained pending the enquiries of the Commission in Madras. He stated that the Madras Plague Manual prescribed definite duties for every class of official on the occasion of an outbreak of plague, and that this had been of great assistance in ensuring early reporting.

Colonel Dyson mentioned that although in Poona rats became immune, as appeared from the course of the present epidemic, in Satara where epidemics occurred year after year, such was not the case.

Dr. Bose said that it was useless to attempt plague measures without the co-operation of the people, through whose inertia and indifference the measures adopted were often rendered nugatory.

Major Stokes drew attention to the inadequacy of the law in compelling reports of the outbreak of a case of plague.

Lieutenant-Colonel Browning Smith said that his experience in the Punjab as to the effect of humidity on plague entirely bore out *Major Liston's* conclusions. A weak monsoon was followed by a mild epidemic and *vice versâ*. He asked what was the longest period for development from the egg to the flea. He said that plague was present in London for 100 years before the epidemic of 1665, including four severe epidemics, and for 25 years subsequently, and feared there was no prospect of a cessation of plague of itself for a very lengthy period. Early information was essential, but was largely a matter of staff. Round Delhi now owing to the staff being sufficient it had reached such a pitch of perfection that when a field rat fell down a well, rat mortality was reported to the plague officer.

Major Lalor put forward *Captain Brayne's* views. They ran along two lines. In the first place he thought that plague in a place generally starts about the same time every year. It establishes a crisis among rats, but after a certain number have been destroyed it stops. His idea was to establish an artificial crisis among rats a month or so before it would ordinarily take place and to slaughter as many as possible; the rat population might thus be reduced to such a number that plague would not take place. This contention had not been finally proved. The second line of argument was that it is not possible to render dwelling houses rat-proof at reasonable cost, but is possible to render them "ratable," *i.e.*, constructed of such material that rats cannot find cover, and must be discovered if boxes and other movables are removed.

The unanimous view of the conference was in favour of the view put forward by

Major Glen Liston, supported by *Surgeon-General Bannerman* and *Sir David Semple*, that it was essential that there should be close co-operation in the future between the laboratory worker, the sanitarian and the clinician.

Major Glen Liston said that he would experiment on the breeds of rats mentioned by *Colonel Dyson*.

Captain Justice in introducing his paper (Appendix 17) on the passporting of grain and grain gunny bags from localities infected with plague stated that the subject of the importance which grain bears in the dissemination of plague might perhaps be investigated by the Plague Commission, and that experiments on the transportation of fleas in gunny bags and grain might be carried out.

Major Glen Liston then read a paper (Appendix 18) written by *Captain Stevenson* on the action of hydrocyanic acid gas on grain and other food-stuffs. He himself considered that it would be extremely difficult to control the transport of gunny bags.

Captain Patton made the following remarks: While studying the life history of the cat flea *Ctenocephalus felis*, I was struck with the fact that the larvæ of this flea, even the smallest, when kept in proximity to the fleas always contain digested blood. It then occurred to me that larvæ may well ingest pathogenic organisms passed out by the flea, and that if they retain this infection in the mature flea on hatching out from such larvæ may constitute a factor in the transmission of the organisms. So little appears to be known regarding the feeding habits of flea larvæ that I venture to suggest that this is a possible method by which plague may be carried by infected larvæ in grain and gunny bags.

Dr. Bose urged caution in the use of hydrocyanic acid gas owing to the danger of men with dilated hearts or any derangement coming into contact with it.

A member here observed that a temperature of 112 degrees in the sun's rays for $\frac{3}{4}$ hour was sufficient to destroy fleas; and there should be no difficulty in disinfecting gunny bags by this means.

General Lukis pointed out that this could not be done in the case of cargoes.

Major Lalor was of opinion that action should be taken rather to adopt measures in advance of plague to prevent its spread than to attempt to prevent its importation, the latter being in the nature of things almost impossible. If large stores and barges were so constructed as to be easily ratable, and if they were ratted regularly, the danger of spread of plague by gunny bags would be minimised.

(d) Other Epidemic Diseases.

A memorandum on the manufacture of glycerinated calf lymph and lanolinated vaccine was read by *Captain Justice* (Appendix 19), while *Captain Patton* explained the cultivation and preservation of cow-pox vaccine as practised at the King Institute, Guindy. A discussion ensued on the question of the supply and immunity of calves, of the advantages of glycerinated as opposed to lanolinated vaccine and of the possibility of the desiccation of vaccine.

Major Clemesha speaking from a knowledge of Madras assured *Captain Patton* that there would be no necessity for a reserve of calves outside Madras City.

Experience in Bengal showed that glycerinated vaccine retained its potency only up to a temperature of 60° Fahrenheit. Above that temperature it deteriorated rapidly. Lanolinated lymph was more robust, instances of decomposition being rare, and on the whole better, though glycerinated lymph might be more suitable for towns where a glycerinated lymph can be manufactured, and if not used, thrown away.

Colonel Wilkinson said that they were not troubled by climatic difficulties in the Punjab as their vaccination season was the cold weather. Epidemics occasionally occurred in the hot weather but they had not found their lymph manufactured in the hills to fail, if used within a week after preparation. Great care was taken in manufacturing a high standard of lymph. The strain was kept up by vaccinating from a cow into a buffalo calf. They kept their own store of calves and did not depend on contractors. Generally speaking the results from glycerinated lymph had been excellent.

Major Robertson stated that in the United Provinces they had trouble over contractors for a good supply of calves. There was no cold storage on the ground of the expense it would entail. The glycerinated lymph was stored in the hills and sent weekly to the plains.

Colonel Hare said that a new dépôt was required in Eastern Bengal and Assam, as at present there was no reserve of vaccine.

Dr. Rutherford stated that only glycerinated lymph was used in Ceylon. It was kept in cold storage and issued twice a week. There were consequently no failures.

Major Stokes mentioned that in the Central Provinces each Civil Surgeon made his

own lymph, and made his own arrangements for a supply of calves. No central depôt existed and the existing arrangements had the merit of cheapness.

Major Lalor stated that calves were purchased in Burma by the Superintendent, Vaccine Dépôt, Meiktila, and were afterwards sold at a loss. The alternative of asking the Veterinary Department to purchase calves, lend them to the Dépôt, and rear them subsequently on forest reserves for sale at a profit to Government, was unfortunately out of the question owing to the prevalence in Meiktila district of rinderpest amongst grazing cattle.

Colonel Dyson referred to a society of Jains which undertook to purchase cattle from Gujarat and to supply calves to the vaccine dépôt. Glycerinated vaccine was in use and the results had been good. The lymph had gone to Aden and had been utilised after a lapse of 20 days. This was, of course, partially due to improved methods of packing and despatching.

Captain Patton, who had written a note on the extraction or preservation of cow-pox vaccine as practised in the King Institute, Guindy, Madras (Appendix 20), dealt with the practical aspects of human vaccination. He said that the operation must be thoroughly performed. Small-pox seldom occurs in a child which has one large scar, and never in cases where two successful vaccinations have been performed. There is no evidence to show that the immunity conferred is less durable in the tropics than in temperate climates. The apparent difference in case incidence amongst the inoculated is due to the greater frequency with which sources of infection are encountered. No person is immune to primary vaccination, and if a failure occurs it is due to improper application, or to deterioration of the virus.

Dr. Bose contributed a paper (Appendix 21) on the spread of tuberculosis in Calcutta, and initiated the discussion. It was agreed that there should be a separate hospital for phthisis wherever possible, and the conference endorsed the recommendations of *Dr. Bose* as to the hygienic measures desirable.

Dr. Bose also read a paper (Appendix 22) on epidemic dropsy or beriberi in Calcutta, and Major Ross put in a note on education and public health (Appendix 23).

The conference then terminated.

APPENDICES TO THE REPORT OF THE FIRST ALL-INDIA SANITARY CONFERENCE.

APPENDIX I.

SCHEMES OF URBAN SANITATION.

From the Hon'ble Mr. L. C. Porter, Secretary to the Government of India, Department of Education, to the Chief Secretary to the Government of Madras; the Secretary to the Government of Bombay, General Department; the Secretary to the Government of Bengal, Municipal (Medical) Department; the Chief Secretary to the Government of the United Provinces; the Secretary to the Government of the Punjab, Home (Medical and Sanitary) Department; the Secretary to the Government of Burma, Medical Department; the Secretary to the Government of Eastern Bengal and Assam, General (Medical and Sanitary) Department; the Hon'ble the Chief Commissioner of the Central Provinces. No. 1538-1545, dated the 21st August, 1911.

With reference to the correspondence ending with your letter* no _____, dated the _____, I am directed to say that the Government of India have recently had under their consideration the recommendation made by the Royal Commission upon Decentralization in India in paragraph 385 of their report regarding the occasional conferences of provincial Sanitary Commissioners with their Sanitary Commissioner.

2. After considering the opinions of the Local Governments consulted on the subject they have decided that such conferences should be held regularly, at convenient centres, at which ideas can be exchanged and first-hand knowledge obtained of what is being done in the matter of sanitation in different places. Other important questions, such as the direct attack upon pathogenic microbes which are known to convey particular diseases, may conveniently be discussed at these conferences.

3. The Government of India will inform { the Government of Madras
Bombay, etc. } of the subjects to
you
be discussed at each conference. In order to enable them to draw up definite agenda the delegates
should be instructed with { the permission of His Excellency the Governor in Council
the permission of His Honour the Lieutenant-Governor in Council }
the permission of His Honour the Lieutenant-Governor
to communicate to the Sanitary Commissioner with the Government of India the subjects which they

* Addressed to the Secretary to the Government of India, Home Department.
† Madras, no. 417, dated the 27th May, 1910. Bombay, no. 229, dated the 13th January 1911. Bengal, no. 1326-Medl., dated the 18th August 1910. United Provinces, no. 3630, dated the 9th August 1910. Punjab, no. 813 (M. & S.), dated the 8th November 1910. Burma, no. 243-M.—5-X-11, dated the 29th April 1910. Eastern Bengal and Assam, no. 4754-G., dated the 22nd July 1910. Central Provinces, no. ¹¹⁶⁷~~VI-14-10~~, dated the 13th August 1910.

propose for discussion, so far as possible, two months previous to the date fixed for the meeting. The discussions will be informal and the conclusions arrived at will in no way be binding on either the Imperial or Provincial Governments. No orders will be passed on the recommendations of these conferences without previously consulting the Provincial Governments concerned.

4. It has also been decided that the next conference, the precise date of which will be subsequently intimated, should be held at Bombay in continuation of the annual meeting of the General Committee for the study of Malaria probably in October or the beginning of November, 1911. I am to request that delegates may be selected to attend both the meetings and to suggest that one of the delegates should be the provincial Sanitary Commissioner.

5. The Government of India think it particularly desirable that definite schemes of urban sanitation extending over a series of years indicating the degree of urgency and the amount of financial assistance required to carry them out within a reasonable period, should be prepared for the different provinces.

() omit in the letter to Central Provinces. I am to request that (with the permission of { His Excellency the Governor in Council
His Honour the Lieutenant-Governor in Council } a report on the subject may, if possible, be submitted to them at an early date with a view to such schemes being discussed at the forthcoming conference.

6. The conclusions of the Government of India on the proposals contained in paragraphs 377 (v) and 384 of the Decentralization Commission's report regarding the appointment, etc., of provincial Sanitary Commissioners and Deputy Sanitary Commissioners will be communicated separately.

From the Hon'ble Mr. L. Davidson, I.C.S., Acting Secretary to the Government of Madras, Local and Municipal Department, to the Secretary to the Government of India, Department of Education. No. 1473-L., dated the 1st November, 1911.

In continuation of my letter no. 3646-1-L., dated 26th October 1911, and with advertence to paragraph 5 of your letter no. 1538, dated 21st August 1911, I am directed to enclose four lists of urban sanitary schemes which the local bodies concerned desire to take up for execution with the assistance of Imperial or Provincial grants.

These lists relate respectively to—

- (i) local fund areas;
- (ii) mufassal municipalities—water-supply and drainage projects;
- (iii) mufassal municipalities—other sanitary schemes;
- (iv) schemes in the City of Madras.

The local fund areas referred to in list no. (1) are small towns under the control of local boards and known in this Presidency as local fund unions. The first item relates to a scheme for which detailed plans and estimates are ready and which is now under the scrutiny of the Sanitary Board. It has been long in incubation and should receive preference to the other 15 items. It is not possible at this stage to indicate the relative order of preference according to which the latter should be dealt with. Other things being equal, it is proposed to give precedence to the items for which detailed plans and estimates have been sanctioned by competent authority before the actual distribution of subsidies takes place. It will also be necessary to examine the extent to which the local bodies concerned have already received assistance of this character and to regulate the distribution with reference to the total amount known to be available. It may be added that if circumstances permit His Excellency the Governor in Council would desire to consult the Finance Committee of the Legislative Council on this question. It is not possible to lay down any hard and fast rule for the determination of precedence in such matters and the rival claims of various local bodies form an appropriate subject for consultation with their elected representatives sitting on the Legislative Council. The relative position of the localities in the matter of urgency will also depend upon the extent to which they are liable to epidemics and the death rate resulting from the prevalence of insanitary conditions. The list, it may be added, has been compiled from applications for assistance put forward in connection with the distribution of the annual sanitary grant of 3½ lakhs and the items represent schemes for the execution of which local funds can make no immediate provision having regard to the other claims upon them.

2. The second list which appertains to water-supply and drainage schemes in mufassal municipalities consists of projects which have reached a comparatively advanced stage, the preliminary investigation being completed and the main outlines already approved by the Sanitary Board. In some cases also detailed plans and estimates are ready and in one or two instances a partial grant has already been promised by Government. The various items have been roughly arranged in order of preference by the Sanitary Commissioner who as a member of the conference at Bombay will be in a position to explain the reasons by which he was influenced. Columns 5 and 6 of the statement call for the following remarks. The local practice with regard to the distribution of Provincial grants-in-aid has been to give precedence to schemes which admit of being financed with a subsidy of one-half the estimated total cost, the balance being found from municipal funds whether by a direct allotment from surplus revenues or by means of a State loan. The figures entered in column 5 represent grants calculated on this basis, allowance being made for sums already promised and available without further assistance from the Government of India. The entries in column 6 represent the maximum subsidy permissible on the assumption that the half-grant rule is not enforced and that sufficient sums are available to meet the entire expenditure for which provision has not already been made. I am to say that the order of preference suggested by the Sanitary Commissioner is merely provisional and will undergo further scrutiny as in the case of the items appearing in list no. (1) when the total grant available is known and the time for actual distribution has arrived. In this case also it is desired, if possible, to consult the Finance Committee of the Legislative Council.

3. The last remark applies to the third list which deals with other sanitary schemes in mufassal municipalities, notably projects for the improvement of congested areas and the extension of house site accommodation. No attempt has been made to detail the order of preference in these cases, but it may be stated that items 1 to 18 should take precedence of items 19 to 25. It has been the practice to give full grants in cases of this character, experience having shown that municipal bodies can seldom finance such projects without crippling their resources and undesirably restricting expenditure on other services.

4. It remains to refer to the fourth and last list which relates to the City of Madras. The three minor items aggregating 3·07 lakhs are applications for assistance towards the opening up of congested areas and the provision of house sites and model dwellings. The Corporation has already carried out a considerable amount of work of this description, but there is ample scope for development and assistance has recently been specifically requested to the extent indicated.

The major item of 77·5 lakhs represents the estimate framed by the Corporation of the amount of funds required in order to finance the extensive water-supply and drainage schemes now in progress and under investigation. The need for financial assistance of this character has already been brought to the notice of the Government of India in Mr. Cardew's letter no. 1598-M., dated 29th October, 1903, when sanction was solicited for a loan of 25 lakhs in addition to a proposed grant of 17 lakhs. Since 1903 the drainage and water-supply work has grown in magnitude. Experience proved that the system of constructing drains was defective and that it would be necessary to supplement the contemplated improvements in the head-works of the water-supply by elaborate and costly distributary arrangements.

The programme of work under both these heads was placed under the control of a special engineer selected in England who has now been at work for nearly four years. This officer has recently devoted particular care to the investigation of the ultimate cost involved. His estimate is that an aggregate sum of approximately 184 lakhs is involved. Excluding work already paid for and funds available for expenditure in the current year there is a balance of some 145 lakhs for which provision must be made. The Corporation on examination of its resources, present and potential, estimates that without unduly starving other branches of the municipal service, it can afford to borrow 67 lakhs. It asks for the balance, *viz.*, 78, or to quote the exact figure, 77·5 lakhs as an outright grant.

According to present anticipations construction work will be spread over a period of at least ten and possibly fifteen years.

LIST OF URBAN SANITATION SCHEMES WHICH REQUIRE GRANT-IN-AID FROM IMPERIAL FUNDS.

(I).—Union Schemes.

Serial No.	Name of local body.	Name of the scheme.	Amount of estimate.	Amount of grant required from Government	Whether detailed plans and estimates are ready.
1.	2.	3.	4.	5.	6.
1	Chingleput District Board.	Water-supply to Saidapet ...	Rs. 1,90,250	Rs. 1,50,000	Yes, under scrutiny with the Sanitary Board.
2	Nellore District Board.	Water-supply to Gudur ...	1,30,000	1,14,000	No, they are approaching completion.
3	Ramnad District Board.	Water-supply to Ramesvaram	1,60,000	1,60,000	No, they are approaching completion.
4	Chingleput District Board.	Drainage of Tiruvallur ...	71,500	66,500	No.
5	Ditto... ..	Drainage of Saidapet ...	1,35,000	1,35,000	No.
6	Godavari District Board.	Improvements to the drainage of Peddapur.	42,000	42,000	No.
7	Coimbatore District Board.	Opening out congested areas in and extending the town of Kollegal.	38,122	38,122	Yes.
8	Tanjore District Board.	Provision of a pumping installation for the supply of water to a portion of Tiruvallur.	28,000	28,000	Yes.
9	Kistna District Board ...	Improving a tank at Gudivada	18,790	18,790	Yes.
10	Bellary District Board ...	Opening out congested areas in the Kampli union.	14,500	9,500	Yes.
11	Kistna District Board ...	Improving a drinking water tank at Gudivada.	11,830	11,830	Yes.
12	Salem District Board ...	Extension of Dharmapuri union.	11,500	11,500	Yes.
13	South Arcot District Board.	Improving a drinking water tank and its supply-channel in the Tindivaram union.	11,000	11,000	No.
14	Ramnad District Board.	Construction of an intercepting drain in the Sivakasi union.	6,200	6,200	Yes.
15	Bellary District Board ...	Opening out congested areas in the Kamalapur union.	5,500	5,500	Yes.
16	South Arcot District Board.	Construction of a reservoir at Panruti with a pumping installation for the supply of water to it from the Gadilam river.	Not known.	5,000	No.
		TOTAL		8,12,942	

(II.)—*District Municipalities—Water-supply and Drainage.*

Serial No.	Name of local body.	Nature of the scheme.	Amount of estimate.	Amount of minimum grant required from Government.	Amount of maximum grant required from Government.	Whether detailed plans and estimates are ready.
1.	2.	3.	4.	5.	6.	7.
1	Tinnevely, Palameotah and Tuticorin Municipalities.	Joint water-supply ...	Rs. 17,08,000	Rs. 8,54,000	Rs. 17,08,000	They are approaching completion.
2	Ellore Municipality...	Water-supply ...	3,16,570	89,870	1,69,870	Yes, under scrutiny in Public Works Department.
3	Masulipatam Municipality.	Ditto ...	4,50,800	2,25,400	4,50,800	Yes, under scrutiny by the Chief Engineer, Public Works Department.
4	Vizagapatam Municipality.	Water-supply to Waltair.	76,500	38,250	76,500	Yes, under scrutiny in Public Works Department.
5	Chingleput Municipality.	Water-supply ...	1,35,000	67,500	1,35,000	They are approaching completion.
6	Madura Municipality	Water-works improvements.	3,00,000	1,50,000	3,00,000	They are approaching completion. (Will be ready in December, 1911.)
7	Ditto ...	Drainage ...	20,72,274	10,36,137	20,72,274	Yes, under consideration by the Sanitary Board.
8	Trichinopoly Municipality.	Ditto ...	6,50,000	3,25,000	6,50,000	They are approaching completion. (Will be ready in December, 1911.)
9	Negapatam Municipality.	Ditto ...	2,30,000	1,15,000	2,30,000	They are approaching completion. (Will be ready in December, 1911.)
10	Vellore Municipality	Ditto ...	3,70,800	1,85,400	3,70,800	Yes, under scrutiny by the Chief Engineer, Public Works Department.
11	Conjeveram Municipality.	Water-works improvements.	1,50,000	75,000	1,50,000	They are approaching completion. (Will be ready in December, 1911.)
12	Tirupati Municipality	Ditto ...	1,50,000	75,000	1,50,000	They are approaching completion. (Will be ready in December 1911.)
13	Adoni Municipality...	Water-works improvements (additional catchment areas).	30,000	15,000	30,000	They are approaching completion. (Will be ready in December, 1911.)
14	Coonoor Municipality	Water-works improvements.	1,00,000	50,000	1,00,000	They are approaching completion. (Will be ready in December, 1911.)
15	Kurnool Municipality	Ditto ...	36,000	18,000	36,000	Yes.
16	Nellore Municipality	Drainage ...	4,00,000	2,00,000	4,00,000	They are approaching completion.
17	Ellore Municipality...	Ditto ...	3,50,000	3,00,000	3,50,000	They are approaching completion.
18	Dindigul Municipality	Water-works improvements.	36,000	15,000	30,000	They are under preparation.
		TOTAL ...	75,55,944	38,34,537	74,09,244	

(III.)—*District Municipalities—Other Sanitary Schemes.*

Serial No.	Name of local body.	Nature of the scheme.	Amount of estimate.	Amount of grant required from Government.	Whether detailed plans and estimates are ready.
1.	2.	3.	4.	5.	6.
1	Adoni Municipality ...	Acquisition of houses and lands for a new road through Underpet and Bharpet.	Rs. 12,393	Rs. 12,393	Yes.
		Cost of laying the road ...	2,708	2,708	Yes.
		Widening existing roads ...	6,964	6,964	Yes.
2	Chidambaram Municipality.	Construction of model huts for toties.	10,120	10,120	Yes.
3	Cocanada Municipality...	Laying out the site acquired for the accommodation of evicted people.	45,345	41,345	Yes.
4	Coimbatore Municipality	Opening up of the Thorayar quarters and accommodation for the evicted people.	70,000	70,000	Yes.
		Removal of congestion in Othachakkara Street and accommodation for the evicted people.	33,000	33,000	Yes.
		Construction of 75 huts for municipal scavengers.	16,200	16,200	Yes.
		Construction of 8 latrines ...	12,000	12,000	Yes.
		Carried over ...			

(III.)—District Municipalities—Other Sanitary Schemes.

Serial No.	Name of local body.	Nature of the scheme.	Amount of estimate.	Amount of grant required from Government.	Whether detailed plans and estimates are ready.
1.	2.	3.	4.	5.	6.
			Rs.	Rs.	
5	Coonoor Municipality ...	Brought forward .. Construction of a Dhobikhana Acquisition of insanitary houses in the native quarters of the town.	16,000 15,000	11,030 15,000	Yes. Yes.
6	Ellore Municipality ...	Opening of congested areas in Gajavallivari-peta. Opening of congested areas in Gollygudem. Opening of congested areas in Gollagudem near Gangana-ma's temple.	64,494 44,325 21,230	64,494 44,325 21,230	Yes. Yes. Yes.
7	Madura Municipality ...	Extension of house sites in the locality known as Madi-chiyam block.	1,00,000	1,00,000	Yes.
8	Mangalore Municipality	Opening up of congested areas	35,046	35,046	Yes.
9	Masulipatam Municipality.	Filling up of insanitary pits...	13,206	13,206	Yes.
10	Negapatam Municipality	Construction of 25 standard latrines.	10,400	10,400	Yes.
11	Nellore Municipality ...	Construction of totie lines ... Seventeen schemes for opening up congested areas.	10,000 4,00,000	10,000 4,00,000	Yes. Detailed estimates have been ordered to be prepared.
12	Ootacamund Municipality.	Acquisition of insanitary and overcrowded buildings in Mainbazaar.	27,000	27,000	Yes.
13	Palamcottah Municipality.	Completion of the scheme of opening milkmen's quarters in the cantonment ward.	12,290	12,290	Yes.
14	Palghat Municipality ...	Construction of 50 totie huts...	10,800	10,800	Yes.
15	Tanjore Municipality ...	Opening up congested areas in the third and fourth wards. Acquisition of land for town extension in Nanjikotai Road.	20,000 10,000	20,000 10,000	Will be ready shortly.
16	Tiruppattur Municipality	Construction of 50 sheds for toties.	10,500	10,500	Yes.
17	Tiruvannamalai Municipality.	Opening up of private scavenging lanes.	19,730	19,730	Yes.
18	Vizianagram Municipality.	Removal of congestion in Belli Street in Santapeta ward and provision of accommodation for the evicted people.	50,000	50,000	Yes.
		Widening the Venemmagari Street.	24,000	24,000	Yes.
19	Adoni Municipality ...	Construction of side drains for the new road through Underpet and Bharatpet.	14,015	14,015	Yes, but awaiting a general drainage survey of the town.
		Construction of side drains in Bazaar Street.	6,609	6,609	Yes, but awaiting a general drainage survey of the town.
		Construction of side drains in Kumbardiddy Road.	13,317	13,317	Yes, but awaiting a general drainage survey of the town.
20	Cocanada Municipality...	Opening up of congested areas in Old Cocanada and Jagannaickpur.	76,241	76,241	Rough estimates ready: will be taken up after the completion of the scheme of laying out new sites—item 3 above.
21	Ellore Municipality ...	Opening up of congested areas in Medaragudem.	28,861	28,861	Yes; will be taken up after the schemes noted as item 6 above.
		Opening up of congested areas in Chakalagudem.	14,186	14,186	Yes; will be taken up after the schemes noted as item 6 above.
22	Madura Municipality ...	Opening up of congested areas in Uppukkara block.	60,000	60,000	No.
23	Palamcottah Municipality.	Opening up of congested areas in the Fort ward.	10,000	10,000	They are under preparation.
24	Tellicherry Municipality	Removal of congestion in the Konkani quarters and provision of house sites for the evicted people.	22,500	22,500	Under preparation.
25	Trichinopoly Municipality.	Relief of congestion in the Fort ward.	40,000	40,000	No.
		Tennore extension schemes ...	24,000	15,000	Rough estimates ready.
		TOTAL ...	14,32,480	14,14,510	

(IV.)

Madras Corporation.

Serial No.	Name of local body.	Nature of the scheme.	Amount of estimate.	Amount of grant required from Government.	Whether detailed plans and estimates are ready.
1.	2.	3.	4.	5.	6.
	Madras Corporation ...	Water-supply and drainage works.	Lakhs. 183.88	Lakhs. 77.5	Detailed plans and estimates have been sanctioned for 51.35 lakhs. Approximate estimates have been prepared for 132.53 lakhs. The works are under execution by a special engineer.
		(i) Opening up and improvement of paracheries.	Rs. 1,05,000	Rs. 1,05,000	
		(ii) Construction of model paracheries.	90,000	90,000	
		(iii) Provision of house sites for poor working classes.	1,12,000	1,12,000	
		TOTAL ...	3,07,000	3,07,000	

From L. Robertson, Esq., I.C.S., Secretary to the Government of Bombay, General Department, to the Secretary to the Government of India, Department of Education. No. 6022, dated the 11th October, 1911.

With reference to the Educational Department communications noted on the margin, I am directed to state, for the information of the Government of India, that the Governor in Council has nominated the following officers as delegates from this Presidency to attend the forthcoming Sanitary and Malaria Conferences in Bombay—

Paragraph 4 of letter No. 1539, dated the 21st August 1911.
 Paragraph 1 of letter No. 1703, dated the 16th September 1911.
 Memorandum No. 1820, dated the 29th September 1911.

To the Sanitary Conference.

The Sanitary Commissioner for the Government of Bombay (Lieutenant-Colonel T. E. Dyson, M.B., C.M., D.P.H., I.M.S.).
 The Sanitary Engineer to Government (Mr. C. N. Mandy, C.E.).

To the Malaria Conference.

The Surgeon-General with the Government of Bombay (The Honourable Surgeon-General R. W. S. Lyons, M.D., I.M.S.).
 The Sanitary Commissioner for the Government of Bombay (Lieutenant-Colonel T. E. Dyson, M.B., C.M., D.P.H., I.M.S.).
 The Director, Bombay Bacteriological Laboratory (Major W. Glen-Liston, M.D., I.M.S.).
 Major F. H. G. Hutchinson, M.B., I.M.S.

2. With reference to paragraph 5 of the Government of India's letter dated the 16th September, 1911, I am directed to forward herewith a list of sanitary works in this Presidency and the amounts likely to be spent on them during the next ten years.

List of sanitary works contemplated in the Bombay Presidency showing the amounts that are likely to be spent on them during the next ten years.

Serial No.	Name of project.	District.	Rough estimate of costs of contemplated projects.	Amounts of grants-in-aid.										Remarks
				1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.	
1	Malegaon water-supply ...	Nasik ...	2,00,000	20,000	30,000	50,000	—	—	—	—	—	—	—	
2	Yeola water-supply ...	Do. ...	3,50,000	30,000	50,000	70,000	25,000	—	—	—	—	—	—	
3	Dhulia water-supply improvements ...	West Khandesh ...	1,00,000	25,000	20,000	—	—	—	—	—	—	—	—	
4	Do. town drainage ...	Do. ...	2,00,000	30,000	30,000	50,000	—	—	—	—	—	—	—	
5	Parola water-supply ...	East Khandesh ...	1,50,000	10,000	20,000	20,000	25,000	—	—	—	—	—	—	
6	Jalgaon drainage ...	Do. ...	2,50,000	10,000	15,000	20,000	25,000	30,000	25,000	—	—	—	—	
7	Dholka water-supply ...	Ahmedabad ...	50,000	5,000	5,000	10,000	5,000	—	—	—	—	—	—	
8	Surat sewerage ...	Surat ...	20,00,000	50,000	1,00,000	1,00,000	1,00,000	1,00,000	2,00,000	2,50,000	1,00,000	—	—	
9	Dakor water-supply ...	Kaira ...	2,00,000	5,000	45,000	50,000	—	—	—	—	—	—	—	
10	Jalgaon do. ...	East Khandesh ...	30,000	30,000	—	—	—	—	—	—	—	—	—	
11	Rajpur sanitary improvements ...	Do. ...	30,000	30,000	—	—	—	—	—	—	—	—	—	
12	Karad water-supply ...	Satara ...	2,00,000	25,000	50,000	25,000	—	—	—	—	—	—	—	
13	Barsi do. ...	Sholapur ...	4,75,000	25,000	50,000	50,000	62,500	50,000	—	—	—	—	—	
14	Sholapur do. ...	Do. ...	3,25,000	45,000	—	—	—	—	—	—	—	—	—	
15	Alibag do. ...	Kolaba ...	26,500	13,250	—	—	—	—	—	—	—	—	—	
16	Lonavla do. ...	Poona ...	4,00,000	25,000	50,000	1,00,000	25,000	—	—	—	—	—	—	
17	Poona drainage and water-supply ...	Do. ...	{ 17,50,000 5,50,000 }	{ 2,75,000 25,000 }	3,00,000	1,75,000	—	—	—	—	—	—	—	
18	Pandharpur water-supply ...	Sholapur ...	—	2,475	—	—	—	—	—	—	—	—	—	
19	Nasik do. ...	Nasik ...	—	96,852	—	—	—	—	—	—	—	—	—	
20	Nandurbar do. ...	West Khandesh ...	2,00,000	—	20,000	30,000	50,000	—	—	—	—	—	—	
21	Rhusawal do. ...	East Khandesh ...	2,00,000	10,000	20,000	20,000	20,000	20,000	30,000	—	—	—	—	
22	Rander town drainage ...	Surat ...	2,00,000	25,000	25,000	25,000	25,000	25,000	30,000	—	—	—	—	
23	Broach water-supply ...	Broach ...	15,00,000	—	25,000	50,000	1,00,000	1,00,000	1,00,000	3,00,000	75,000	—	—	
24	Godhra do. ...	Panch Mahals ...	2,00,000	10,000	10,000	20,000	20,000	50,000	—	—	—	—	—	
25	Dohad do. ...	Do. ...	1,00,000	20,000	20,000	20,000	10,000	—	—	—	—	—	—	
26	Uran do. ...	Kolaba ...	4,00,000	—	50,000	50,000	50,000	—	—	—	—	—	—	
27	Ahmednagar do. ...	Ahmednagar ...	6,00,000	—	50,000	1,00,000	1,25,000	25,000	—	—	—	—	—	
28	Nadiad do. ...	Kaira ...	3,00,000	—	—	20,000	30,000	30,000	30,000	40,000	—	—	—	
29	Matheran do. ...	Thana ...	1,50,000	—	—	25,000	25,000	25,000	—	—	—	—	—	
30	Sukkur do. ...	Sukkur ...	1,50,000	—	—	37,500	37,500	—	—	—	—	—	—	
31	Malegaon town drainage ...	Nasik ...	2,00,000	—	—	20,000	20,000	30,000	50,000	—	—	—	—	
32	Yeola do. ...	Do. ...	2,50,000	—	—	—	—	50,000	50,000	—	—	—	—	
33	Nandurbar do. ...	West Khandesh ...	2,00,000	—	—	—	25,000	50,000	50,000	—	—	—	—	
34	Dakor do. ...	Kaira ...	1,50,000	—	—	—	25,000	25,000	25,000	—	—	—	—	
35	Godhra do. ...	Panch Mahals ...	1,50,000	—	—	—	25,000	25,000	25,000	—	—	—	—	
36	Islampur water-supply ...	Satara ...	2,50,000	—	—	—	25,000	50,000	50,000	—	—	—	—	
37	Belgaum do. ...	Belgaum ...	13,00,000	—	—	—	50,000	1,00,000	2,00,000	2,00,000	1,00,000	—	—	
38	Nipani do. ...	Do. ...	1,00,000	—	—	—	25,000	25,000	—	—	—	—	—	
39	Parola town drainage ...	East Khandesh ...	50,000	—	—	—	10,000	10,000	15,000	—	—	—	—	
40	Virangaon water-supply ...	Ahmedabad ...	2,00,000	—	—	—	20,000	30,000	30,000	30,000	20,000	—	—	
41	Broach town drainage ...	Broach ...	10,00,000	—	—	—	1,00,000	1,00,000	1,00,000	1,00,000	2,00,000	—	—	
42	Dohad drainage ...	Panch Mahals ...	50,000	—	—	—	10,000	10,000	10,000	5,000	—	—	—	
43	Nasik do. ...	Nasik ...	2,50,000	—	—	—	—	62,500	62,500	10,000	—	—	—	
44	Anandner do. ...	East Khandesh ...	50,000	—	—	—	—	—	10,000	10,000	5,000	—	—	
45	Dhanduka water-supply ...	Ahmedabad ...	2,00,000	—	—	—	—	—	20,000	30,000	30,000	20,000	—	

From L. Robertson, Esq., I.C.S., Secretary to the Government of Bombay, General Department, to the Secretary to the Government of India, Department of Education. No. 6096, dated the 14th October, 1911.

In continuation of my letter No. 6022, dated the 11th instant, I am directed to forward herewith a supplementary list of schemes for town improvement and surface drainage in urban areas and the amounts that are likely to be spent on them in 1911-12 and subsequent years.

List of schemes for town improvement, surface drainage in urban areas, etc., showing the amounts that are likely to be spent on them in 1911-12 and subsequent years.

Serial No.	Name of project.	District.	Rough estimate of costs of contemplated projects.	AMOUNTS OF GRANTS-IN-AID.		REMARKS.
				(Sanctioned) 1911-12.	(Proposed) 1912-13 and subsequent years.	
1	Filling up an insanitary tank in Broach ...	Broach ...	Rs. 26,775	Rs. 25,000	Rs. —	*Of this Rs. 9,000 will be paid by the municipality.
2	Opening out congested areas in Ahmedabad City.	Ahmedabad	1,00,000	50,000	—	
3	Street improvement and surface drainage in the town of Bhingar.	Ahmednagar	20,900	20,900	—	
4	Street improvements in Nasik City ...	Nasik ...	1,00,000	25,000	—	
5	Opening out the congested area near the Vithoba Temple at Pandharpur.	Sholapur ...	36,000*	27,000	—	
6	Building a wall round Upliburuz Idga in Bijapur town to prevent people committing a nuisance there and thereby improving the present insanitary conditions.	Bijapur ...	500	500	—	
7	Improvements to gutters in wards I, III, IV and VI in Bijapur town	Do. ...	5,000	5,000	—	
8	Improving drains behind the post office and Kal Peth in the town of Bagalkot.	Do. ...	1,200	1,200	—	
9	Drainage channel to carry off storm water which at present floods the whole town of Guledgud.	Do. ...	4,000	4,000	—	
10	Drainage of the Mussalman quarter of the town of Ranebennur.	Dharwar ...	6,800	6,800	—	
11	Drainage of the Koney nullah in Karwar town	Kanara ...	11,000	11,000	—	†Proposed to be held in reserve for allotment if a suitable scheme can be prepared.
12	Filling in the Kafila serai tank in Larkana ...	Larkana ...	10,000	10,000	—	
13	Opening out congested areas in Surat City ...	Surat ...	1,50,000	—	50,000	
14	Opening out congested areas and surface drainage in Poona City.	Poona ...	Not ascertained.	—	50,000	
15	Opening out congested areas by the removal of Chambhar Wada near the Kumbhar Gate in Sholapur City.	Sholapur ...	25,000	—	25,000	
16	Opening out congested areas and construction of surface drainage in Belgaum.	Belgaum ...	Not ascertained.	—	62,500	
17	Construction of rat-proof godowns in Belgaum with the view of checking the dissemination of plague.	Do. ...	Do.	—	Not ascertained.	
18	Widening of streets and improvement of surface drainage in Athni.	Do. ...	Do.	—	25,000	
19	Widening of the street from Chandabavadi to municipal naka in Khodanpur Peth in Bijapur.	Bijapur ...	Do.	—	5,000	
20	Opening up congested areas and surface drainage in Dharwar.	Dharwar ...	Do.	—	30,000†	
21	Continuance of the work of driving streets through congested areas in Hubli.	Do. ...	Do.	—	50,000	†Set aside for distribution when approved schemes have been prepared. Certain questions regarding financial arrangements have been referred to the Government of India.
22	Opening out insanitary areas in Pen ...	Kolaba ...	Do.	—	Not ascertained.	
23	Sanitary improvements in Sind ...	Sind ...	—	—	50,000‡	
24	Opening out congested areas in Ahmedabad...	Ahmedabad	20,00,000	—	—	

From H. Wheeler, Esq., C.I.E., I.C.S., Secretary to the Government of Bengal, Municipal Department, to the Secretary to the Government of India, Education Department (Sanitary). No. 963-T. M., dated the 5th October 1911.

I am directed to acknowledge receipt of your letter No. 1538-1545, dated the 21st August 1911, in paragraph 5 of which it is requested that a definite programme should be submitted of schemes of urban sanitation extending over a series of years, indicating the degree of urgency of each and the amount of financial assistance required to carry them out within a reasonable period.

2. In my letter No. 173-M., dated the 26th January 1911, the procedure was outlined according to which projects of water-supply and drainage are ordinarily initiated. The original impetus may come from the efforts of the District officer, an inspection by an officer of the Sanitary Department, the generosity of some local resident, or similar cause and wish having been expressed that such a work should be undertaken, the assistance of the Sanitary Engineer is given in the preparation of a rough project. The question of finance then arises, and not infrequently presents various difficulties. The co-operation of the local authority has to be secured, and its willingness to take a loan or to raise additional revenue ascertained; private liberality has to be approached, and finally the amount of the grant to be given by Government is fixed in consideration of these different factors. These matters having been settled, the detailed plans and estimates are drawn up, the necessary funds are placed at the disposal of the local body and work is commenced.

3. Such being the actual practical working of all efforts towards the execution of sanitary improvements, it is not possible to frame a programme such as is apparently contemplated by the Government of India. Lists specifying the proposals for schemes of (a) water-supply and (b) drainage, which, for the moment are under discussion, are herewith submitted, and it will be seen that the total estimated cost under the first head amounts to Rs. 59,89,000 and under the second to Rs. 78,54,000. It is impossible to specify the exact order in which these works will be taken up, according as each can be pushed through, assistance will be given to it by Government in proportion to the sums realised from other sources and the Budget provision available, but anything in the nature of a programme is impracticable. All the improvements specified are desirable, and the sooner they can be carried through the better, but the rate of progress made with each will depend largely upon the local enthusiasm and energy evinced, over which Government can exercise little control. Apart from the fact that the schemes referred to are of sufficient magnitude to occupy the time of the sanitary staff which is at the disposal of the local Government, it will be obvious that it is still more impossible to frame a programme of the improvements necessary in other parts of the Province, from which no desire has as yet been expressed for the formulation of a scheme. Such requests will doubtless arise in time, and will then be dealt with, but a paper programme proposing to deal with different municipalities in a specified order would be of no real value; on the contrary, it would tend to throw a greater part of the expense on Government direct, while less was obtained from local bodies and from private sources. No attempt, therefore, has been made to prepare such a programme. There is room for the improvement of sanitation everywhere, but the different degrees of urgency of individual projects is not so much a point in issue as the provision of funds, and that depends mainly on local effort. According as each scheme matures, the local Government is prepared to help it to the utmost according to the state of its financial resources at the time, but it is not possible to say beforehand when each demand will occur and the amount of the expenditure which it will involve.

STATEMENT A.

Water-supply schemes which are at present under discussion.

No.	Locality.	Description of scheme.	Estimated total cost.
1	Jherria coalfields	Water-supply (1) Pumping. (2) Gravitation scheme.	Rs. 25,00,000
2	Khulna Municipality	Extension of existing water-supply	19,000
3	Kalna "	Pumping water from the river and filtering	86,000
4	Bankura "	Pumping water from wells	32,000
5	Patna "	Combined flushing and filtered water-supply	12,00,000
6	Howrah "	Extension of existing water works	15,00,000
7	South Suburban Municipality	Extension of pipe lines	12,000
8	Asansole Municipality	Water-supply (sketch project)	1,86,000
9	Mazaffarpur Municipality	Water-supply	4,54,000
		Total	59,89,000

STATEMENT B.

Surface drainage schemes which are at present under discussion.

No.	Locality.	Description of scheme.	Estimated total cost.
1	Katwa Municipality	Surface drainage	Rs. 77,433
2	Jessore "	Ditto	4,10,368
3	Kalna "	Ditto	2,60,137
4	Bettiah "	Ditto	2,43,058
5	Hooghly-Chinsurah Municipality	Ditto	8,79,368
6	Suri Municipality	Ditto	1,45,000
7	Midnapur "	Ditto	3,78,484
8	Azimgunge "	Ditto	1,46,052
9	Ranaghat "	Ditto	45,751
10	Gaya "	Surface drainage and partial sewerage	6,80,000
11	Maniktolla "	Ditto ditto	19,80,000

No.	Locality.	Description of scheme.	Estimated total cost.
			Rs.
12	Sahebgunge „	Surface drainage	51,297
13	Kushtea „	Ditto	23,688
14	Ranchi „	Ditto	2,06,454
15	Cossipore-Chitpur Municipality	Ditto	12,40,515
16	Purulia Municipality	Ditto	2,25,000
17	North Barrackpur Municipality	Ditto	1,68,016
18	Bhadreswar Municipality	Ditto	79,000
19	Motihari „	Ditto	84,000
20	Serampur	Ditto	5,30,600
		Total	78,54,221

REVISED STATEMENTS FURNISHED BY THE SANITARY ENGINEER, BENGAL.

STATEMENT A.

Water-supply schemes which are at present under discussion in Bengal.

No.	Locality.	Description of Schemes.	Estimated total cost.
			Rs.
1	Monghyr	Unfiltered water pumping station	1,05,000
2	Puri	Water-supply from filtration gallery in sand hills	3,00,000
3	Jherria Coalfields	Water-supply, Uplands Gravitation Scheme	37,50,000
4	Howrah	Water-supply improvement scheme	15,00,000
5	Patna	Water-supply approximate estimate	20,00,000
6	Asansole	Water-supply from well in river bed (sketch project)	1,85,000
7	Ranchi	Water-supply approximate estimate	4,00,000
8	Muzaffarpur	Filtered water-supply from river	4,54,000
9	Bankura	Water-supply from wells in river bed	42,500
10	Kalna	Filtered water-supply from river	89,000
11	Uttarpara	Water-supply from Howrah water-works	1,00,000
12	Burdwan	Water-supply improvement scheme	2,00,000
13	Balasore	Water-supply for wells (rough project)	1,20,000
14	Midnapur	Water-supply (rough project)	2,50,000
15	Baranagore	Water-supply from Calcutta water-works	4,76,000
16	Murshidabad	Filtered water-supply from river	1,06,000
			1,00,77,500

STATEMENT B.

Surface Drainage and Sewerage Schemes which are at present under discussion in Bengal.

No.	Locality.	Description of Scheme.	Estimated Total Cost.
			Rs.
1	Gaya Municipality	Surface drainage and partial sewerage	7,00,000
2	Ranaghat	Surface drainage	46,000
3	North Barrackpur Municipality	Ditto	1,68,000
4	Purulia Municipality	Ditto	1,46,000
5	Kushtea	Ditto	25,000
6	Bhadreshwar	Ditto	85,000
7	Bettiah	Ditto	1,50,000
8	Cossipore-Chitpur Municipality	Ditto and sewerage (approximate estimate)	20,00,000
9	Sahebgunge Municipality	Ditto	51,000
10	Chapra	Ditto	1,86,000
11	Katwa	Ditto	54,000
12	Kalna	Ditto	40,000
13	Kissengunge	Ditto	31,000
14	Jessore	Ditto	2,50,000
15	Hooghly Chinsura Municipality	Ditto	8,80,000
16	Bankura Municipality	Ditto	7,500
17	Suri	Ditto	39,000
18	Howrah	Sewerage—approximate estimate	25,00,000
19	Asansole	Surface drainage	58,000
20	Muzaffarpur	Sewerage	3,10,000
21	Berhampur	Surface drainage	2,00,000
22	Bhagalpur	Ditto	7,00,000
23	Serampur	Ditto	1,58,000
24	Motihari	Ditto	50,000
25	Maniktolla	Surface drainage and partial sewerage	19,80,000
26	Ranchi	Surface drainage	2,06,000
27	Midnapur	Ditto	1,50,000
28	Azimungunge	Ditto	1,46,000
29	Murshidabad	Ditto	3,00,000
30	Uttarpara	Ditto	58,000
31	Behar	Ditto	88,000
			1,17,62,500

From the Honourable Mr. L. Stuart, I.C.S., Secretary to the Government of the United Provinces, Sanitation Department, to the Secretary to the Government of India, Home Department, No. 1-L.K.O., dated the 28th October, 1911.

With reference to the correspondence ending with the letter of the Government of India, No. 1541, dated the 24th August, 1911, I am directed to forward the following schemes for improvement of urban sanitation in the United Provinces with a view to their being discussed at the forthcoming conference at Bombay.

2. These schemes are contained in the annexures to this letter—

- (1) Works to be undertaken.
- (2) Projects to be prepared.
- (3) Notes on the financial position of places mentioned in the programme.

Every endeavour has been made to bring these schemes up to date. But as the time for preparation has not been long, it is possible that there may be a few unimportant omissions in the figures of grants made towards the various projects.

3. All the schemes in question have been carefully considered by the Sanitary Board of this province, and the 26 schemes in the first list may be ranked as of real urgency and of public utility. Schemes Nos. 1-8 and 12 and 13 in the second list are of urgency and of public utility. Nos. 9, 10 and 11 have not yet been thoroughly examined. In the case of all schemes that have been examined the only question remaining is that of the provision of funds. There can be no doubt as to the necessity of the improvements. There is considerable reluctance on the part of municipal boards to enter on such big schemes, as, in the majority of instances, the boards can see no prospect of providing funds. It appears that the best method of overcoming this reluctance is to give grants to start the work on condition that the board completes the work or a specified portion of it. In cases of drainage the best policy is often to make a grant for a main drainage and outfall system leaving over till later the final completion of subsidiary drains and the paving of lanes.

4. If the Government of India can supplement the generous assistance, which this province has already received from them for schemes of urban improvement, I am to suggest that the following grants will be of the greatest possible value :—

	Rs.
(1) A grant to the Fyzabad Municipality (List 1, No. 3) of	1,00,000
(2) A grant to the Saharanpur Municipality (List 1, No. 4)	50,000
(3) A grant to the Shahjahanpur Municipality (List 1, No. 5)	1,00,000
(4) A grant to the Etawah Municipality (List 1, No. 9)	50,000
(5) A grant to the Mainpuri Municipality (List 1, No. 10)	1,00,000
(6) A grant to the Dhampur Municipality (List 1, No. 11)	70,000
(7) A grant to the Meerut Municipality (List 1, No. 12)	1,50,000
(8) A grant to the Jhansi Municipality (List 1, No. 13)	1,00,000
(9) A grant to the Aligarh Municipality (List 1, No. 15)	1,00,000
(10) A grant to the Fatehpur Municipality (List 1, No. 16)	50,000
(11) A grant to the Cawnpore Municipality (List 1, No. 25)	1,00,000

The case of the Agra Municipality may also be mentioned. No project from Agra appears on the programme. There is great need of sanitary improvement in the town but the finances of the municipality are in such a bad condition that the municipal authorities have not considered it worth while to put up proposals. The question of improvement of water supply and drainage in Agra is now pressing, and a grant of 1 lakh of rupees for the first and 5 lakhs of rupees for the second object to this municipality would be of enormous value.

5. It will be seen that in many cases the municipalities suggest the enhancement of octroi duty as the only method of providing the requisite funds. As proposals have been made to abolish the levy of octroi, it is clear that this source of income may be left out of account. It is difficult to suggest any other method of enhancing municipal resources. The grants suggested form a modest portion of the amount which can be usefully expended at once, without incurring the danger of pauperising municipal boards. If more money be available, grants for the greater part of the funds required for the sanctioned schemes may be given with great advantage. Further grants to Lucknow, Cawnpore, Allahabad, Benares and Gorakhpur for the cost of town improvement schemes would also produce incalculable benefit. It has not been possible to work out such town improvement schemes in detail. It is, however, suggested that anything which the Government of India may choose to give for such purposes can be expended usefully.

PROGRAMME OF SANITARY WORKS, UNITED PROVINCES, ARRANGED IN ORDER OF URGENCY.

I.—Works to be undertaken.

Names of places.	Description of work and its estimate.	Remarks by Government.	REPLIES RECEIVED FROM THE MUNICIPALITY ON THE THREE POINTS RAISED BELOW.				Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, if taken.			
1. Khurja ...	Drainage works. costing Rs.1,37,840.	Part of the cost would be met from the cash balance which at the close of the year 1908-09 amounted to Rs. 42,364 and a loan of a lakh would probably be necessary, the Board should be able to afford this. In 1908 the Board had a surplus income of Rs. 16,000 without allowing any sum for original works, but subsequently a decline in the octroi income disturbed the financial position. The Board should be able to finance the scheme, but enquiry will be necessary before the project is placed on the programme.	Rs. 44,000	Rs. 54,973	By taking a loan of 1 lakh of rupees which will be repaid without levying fresh tax.	This project was prepared by Mr. Standley and sent in and sanctioned just after I took charge. I believe the municipality are thinking of starting on a portion of the work.	Classed as ready and urgent.	
2. Hapur ...	Drainage works estimate, Rs.2,08,893.		41,000	1907-56,010 1908-45,189 1909-44,067	By taking a loan to be repaid by 40 half-yearly instalments of equal amount.	The Collector of Meerut (Mr. L. Porter) pressed urgently for this project and it got out in record time in March 1909, and was finally sanctioned by Sanitary Board and Government. They intended to finance 1 lakh's worth of it but nothing has been done. The Board in letter No. 307, dated the 7th October 1910, said that they had applied for a 1 lakh loan in 1909. Rs. 12,000 for land and Rs. 7,735 for new station road has been made in the budget and the work is in progress. Rs.19,735 should be excluded from the total amount.	Ditto.	
3. Fyzabad ...	Drainage works estimate, Rs.3,79,533 —1,71,481.	Nothing can be done towards the execution of the scheme till either taxation is raised or the Government is in a position to give assistance.	No funds. Nothing can be said towards the execution of the scheme till either taxation is raised or Government gives assistance.	1,12,574	Enhancement of octroi duty.	This project has been finally passed by Government and Sanitary Board. But the Board so far have not been able to finance any part of it. I believe they intend to take up the Fatehganj nala portion which although forming part of the whole scheme is a separate piece by itself, but so far nothing has been started.	Classed as ready and urgent.	
4. Sahranpur...	Drainage works estimate, Rs.3,69,808.	The Board can finance the complete scheme.	1,61,000	1,47,545	Application made to Secretary, Sanitary Board, for a grant of Rs.2,00,000. Will not take a loan but raise the octroi duty.	The final project is now before Government. The Board asked for Rs.2,00,000 from the Sanitary Board to enable them to start.	...	
5. Shahjahanpur.	Drainage works estimate, Rs.6,57,416.	Here also the octroi figures vary a great deal from year to year so that it will be necessary to ask the Board to work out a normal budget and to state clearly its financial position.	6,000	1,39,000	...	This scheme is now with the Municipal Board. They are awaiting the return of Mr. Tyler before doing anything further.	...	

Names of places.	Description of work and its estimate.	Remarks by Government.	REPLIES RECEIVED FROM THE MUNICIPALITY ON THE THREE POINTS RAISED BELOW.			Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, is taken.		
14. Allahabad ...	Drainage works, Rs.18,32,628.	The Municipal Board has been asked to clear up the financial position, and a further communication will be made when their report is received.	Rs. 20,000	Rs. 5,67,941	Will not take a loan, asks Sanitary Board to make a grant of five lakhs.	The scheme has now been revised by Messrs. Lane Brown and Hewlett and is now with me. It is, I think, a considerable improvement on the original scheme and is some lakhs cheaper. But unless the municipality can finance a sum of about 5 lakhs not much can be done, as the first works must be the pumping station and the sewage main across the Jumna. The Board have stated they are not in a position to finance further loans till 1912. They have asked Government to come to their assistance and make a special grant of 5 lakhs or some such sum as will enable them to make a start.	Classed as ready and urgent.
15. Aligarh ...	Drainage works, Rs.5,50,000.	The Board can afford to take a loan of about 5½ lakhs and it has Rs.28,200 invested. But if the whole scheme is taken up and further taxation is necessary, the Municipal Board must be addressed on the financial question.	90,000	54,540	It will probably be decided to take up the works by instalments and to finance it by small increases of taxation, but details cannot be given till the scheme is sent.	This scheme has lately been completed, and is now being considered by the Board.	
16. Fatehpur ...	Drainage works, Rs.1,80,000.	The surplus of income over the expenditure is about Rs.3,500 a year; the Municipal Board reported that it would take up work on the scheme from time to time as funds were available, and in view of this fact it is for the Sanitary Board to consider if the scheme should be proceeded with.	10,000	22,218	It is not proposed to take a loan or raise any additional income.	This scheme is under preparation, and will be completed by the end of the year. The Board have Rs. 20,000. They propose to carry it out, by their own agency, piecemeal.	Classed as ready and urgent.
17. Haridwar ...	Drainage works, Rs.1,00,000.	The scheme should be explained to the Commissioner, who will decide whether any part of its cost can be met from fair fund account. The balance in this account at the close of the year 1908-9 was Rs.42,059, and the income exceeds the outlay by about Rs.15,000; a normal budget of the ordinary income and expenditure indicates a surplus sufficient to cover the charges on a	Board can devote Rs.10,000, during next year for the work.	1907-8—55,981 1908-9—54,791 1909-10—52,921	The Board suggests the work to be done in three years and is prepared to pay Rs.30,000 and proposes that the balance, Rs.20,000, be met from the fair fund; it is not proposed to take a loan, but to en-	This scheme is still under preparation and will be submitted about January.	Ditto

26432	18. Atrauli ...	Drainage works, Rs. 1,25,000.	On a normal budget the marginal works work out to Rs. 2,000. The Board should be addressed.	14,000	17,013	hance the octroi duty on goods and the pilgrim tax. It is not desired to take a loan or levy additional taxes. Unable to carry out the scheme.	The scheme is nearly ready. This is a small muni- cipality, and one that the Sanitary Board might help. The Board say that they cannot finance it. The Board have definitely decided that the project is altogether too ambitious a one for them to attempt, and I rather agree with them, as it involves pumping.	Nos. 20 to 26 added by the Sanitary Board, as being of importance. The projects, however, are not yet ready.
	19. Amroha ...	Drainage works, Rs. 2,67,543.	A normal budget indicates a possible surplus of only Rs. 3,000, and it seems necessary to ascertain from the Municipal Board in what stage it proposes to carry out the scheme and how provide funds.	...	...	...	...	...
	20. Landour ...	Drainage, Rs. 2,00,000.	...	...	...	...	...	...
	21. Lucknow ...	Waterworks, Gau- ghat, Rs. 4,00,000.	...	...	...	...	...	...
	22. Naini Tal ...	Latrines and pail depôts, Rs. 1,00,000.	...	...	...	...	...	...
	23. Mirzapur ...	Waterworks, Rs. 6,32,000.	...	...	...	...	...	...
	24. Benares ...	Sewerage and sur- face drainage scheme, Rs. 2,00,000.	...	...	...	...	...	...
	25. Cawnpore ...	Improving conser- vancy tranway, draining Collec- torganj and Lach- manpurwa, Rs. 58,000.	...	...	...	...	...	...
	26. Lucknow ...	Town improve- ment, Rs. 2,40,000.	...	...	...	...	...	...

W. G. WOOD, Superintending Engineer,
Sanitary Engineer to Government, United Provinces.

PROGRAMME OF SANITARY WORKS, UNITED PROVINCES, ARRANGED IN ORDER OF URGENCY.

II.—*Projects to be prepared.*

Names of places.	Description of work and its estimate.	Remarks by Government.	REPLIES RECEIVED FROM THE MUNICIPALITY ON THE THREE POINTS RAISED BELOW.			Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, if taken.		
1. Bahraich ...	Drainage project, costing Rs. 4,14,872.	...	Rs. ...	Rs. ...	...	The Board are now pressing to commence work on part of the scheme drawn up by Mr. Lane Brown. Up to now I have not seen the scheme, and have had no chance of going to Bahraich, so that I fear it must wait. But I will take an early opportunity of examining the scheme. I fear it will take some time to revise it in accordance with present instructions.	
2. Benares ...	...	...	...	...	...	I submitted two projects lately — one for the drainage of two areas in the pakka mahals, and one for the construction of a sewer to take the sullage of the Orderly bazaar across the Burna river, and deliver it into the large main sewer.	
3. Muttra ...	Drainage works ...	...	No funds ...	24,200	Enhancement of octroi duty and raising a subscription.	I have so far been unable to examine this project. It is an old one of Mr. Lane Brown's and will probably require to be revised in accordance with the present system.	
4. Brindaban ...	Ditto ...	...	30,000 which is the amount allotted by the Sanitary Board.	...	Ditto ...	Ditto	
5. Etah ...	Ditto ...	...	...	...	The Board do not require a loan or any assistant in construction but propose to construct their own drains year by year out of current funds.	I have lately completed a map of this municipality, but so far have not commenced drawing up a project.	
6. Ghazipur ...	Drainage works, costing Rs. 4,35,688.	...	25,000	51,000	By further taxation and getting a loan of Rs. 75,000.	I have been over Mr. Lane Brown's project for this place; a good deal of it can I hope be utilised, but it will require a great deal of revision.	
7. Tilhar ...	Drainage works ...	...	15,878	35,817	It is proposed to raise the income by further taxation.	The survey of this place has been made, but the mapping has been delayed owing to the surveyor having got ill, and he has not been able to do anything for 1½ months.	

From The Honourable Mr. L. Stuart, I.C.S., Secretary to the Government of the United Provinces, Sanitary Department, to the Secretary to the Government of India, Education Department. No. 693, dated the 11th November, 1911.

In continuation of the correspondence ending with my letter No. 1-L.K.O., dated the 28th October, 1911, I am directed to state that the programme of schemes for urban improvements was again considered by the Sanitary Board at its meeting on November 1st. In accordance with the recommendations made by it I am to add the following notes on schemes for which grants are required :—

- (1) Hardwar water-works scheme. A scheme for this was prepared some years ago but was dropped owing to want of funds. A grant of 3½ lakhs is requested here.
- (2) Muttra water-works and drainage. The scheme is under preparation. The water-supply is the worst in the province. Considering the importance of Muttra as a place of pilgrimage, it is essential that something should be done to improve the water-supply. A grant of 3 lakhs is requested here.
- (3) Cawnpore. In addition to the minor sanitary schemes of an urgent nature for which a grant of a lakh was suggested in my former letter the municipal board has a comprehensive scheme for paving lines to facilitate drainage. The total cost is considerable and progress is very slow. A further grant of one lakh could be spent to great advantage.
- (4) A drainage scheme for Ballia is in the course of preparation, and as the town has recently been rebuilt on a new site owing to erosion of the old site by the Ganges, it is very important that a drainage system on sound lines should be undertaken. The estimated cost is 1½ lakhs. A grant of Rs. 50,000 could be very usefully expended.
- (5) A drainage system has been introduced into Dehra Dun. It requires extension, and a grant of Rs. 10,000 could be usefully spent.
- (6) A scheme of flushing drains already constructed is under preparation for Muzaffarnagar, which is estimated to cost Rs. 50,000. A grant of Rs. 25,000 could be usefully expended.
- (7) Improvements in the water-works at Benares are required to make the supply continuous, and a large sum could profitably be expended on extensions of drainage. A grant of a lakh of rupees is desired here.
- (8) The drainage works in Jaunpur already undertaken have been stopped for lack of funds. Two and a half lakhs are required to complete them. A grant of Rs. 50,000 could be usefully expended at once.
- (9) Drainage work in Kheri is at a standstill for want of funds, and the main drain put down is useless for want of subsidiary drains. This is a small place with very limited finances. The scheme could be completed for Rs. 27,000 and a grant of that amount would be of enormous advantage.
- (10) The Sanitary Board has strongly recommended that the grant for Shahjahanpur should be raised to 1½ lakhs instead of one lakh as proposed in my former letter.
- (11) It is also suggested that the grant for Fatehpur should be 1½ instead of a lakh as proposed in my former letter.
- (12) Work on the drainage system at Budaun has been suspended for want of funds. The grant of a lakh of rupees to this municipality would be of great advantage.
- (13) At present the sullage from Lucknow, which has been provided with an excellent drainage scheme, is discharged on two sullage farms. But this arrangement is not altogether satisfactory, and a scheme is under consideration to pump part of the sullage across the Gumti to a more suitable site. A sum of Rs. 41,000 will be required.
- (14) A further grant of one lakh is requested to enable other sections of the Lucknow drainage system to be taken up.
- (15) A project for the drainage of Brindaban, an important place of resort by Hindu pilgrims, was prepared, some years ago, and is now being revised by the Sanitary Engineer. The total cost will amount to several lakhs, and a grant of two lakhs is requested.
- (16) The total cost of the water-supply scheme at Mirzapur, now under construction, is estimated at Rs. 598,000. Towards this grant Rs. 140,000 have already been made. The Lieutenant-Governor would be glad to be in a position to give further assistance to the amount of Rs. 50,000 as the board has increased taxation to finance the scheme and is faced with the possibility of a reduced income owing to the abolition of octroi.
- (17) From the grants made by the Government of India last January, a sum of one lakh was set aside for a drainage scheme at Atrauli, estimated to cost Rs. 188,000. Atrauli is a small place with little trade, and the municipal board has been unable to find the balance of the money required to complete the scheme, though it was prepared to find Rs. 25,000. The Lieutenant-Governor has therefore transferred the grant to Aligarh, where a large scheme has been prepared, and where the need was more urgent. The Sanitary Board has, however, again recommended that a grant of a lakh should be made to Atrauli, without conditions as to completion of the scheme. This sum will enable the board to construct a substantial portion of the scheme. It may then be left to the board to complete it in time as funds become available.

From—the Honourable Mr. H. P. Tollington, I.C.S., Revenue Secretary to the Government of the Punjab. To—The Secretary to the Government of India, Education Department. No. 871-M. and S., dated the 2nd November, 1911.

In continuation of my telegram, No. 31-M., dated the 30th October, 1911, I am directed to forward a list of schemes of urban sanitation in the Punjab, arranged according to Divisions, as the Sanitary Board have not been able to work out the order of urgency. As regards the financial assistance that will be required, the Lieutenant-Governor is of opinion that local bodies should be asked to contribute to the cost of the schemes according to the following scale :—

- (a) one-fourth of their total annual income for not more than three years, or
- (b) one-third of the total cost of the scheme spread over not more than three years, whichever is less.

List of urban sanitary projects in the Punjab—1911.

Division.	District.	Municipality.	Population, Census 1901.	Income 1909- 10.	Incidence of taxation, 1909-10.	Nature of project.	Estimate of cost.	REMARKS.
								<i>Note.</i> —All projects except those marked with an asterisk are included in Divisional Statements of Sanitary Projects to be carried out in 5 years from 1910.
DELHI.	Hissar ...	—	—	Rs. —	Rs. a. p. —	Drainage works at Hissar.	Rs. 25,600	Rough estimates including the cost of draining cattle farm at Hissar were prepared and approved by Sanitary Engineer.
	Hissar ...	—	—	—	—	Water-supply for Bhiwani.	1,00,000	The project was abandoned for want of funds.
	Hissar ...	Hansi ...	16,523	21,022	0 15 10	Drainage and filling of tanks.	22,270	Project in accordance with orders of Government. Rough plans and estimates prepared, an anti-malaria project.
	Rohtak ...	Rohtak* ...	19,766	26,094	0 15 1	—	—	Scheme under consideration. Plans and estimates not yet completed.
	Gurgaon ...	Rewari* ...	27,295	48,800	1 6 11	Water-works ...	—	Wells have been sunk; estimate not yet quite complete.
	Gurgaon ...	Palwal* ...	12,830	24,008	1 10 8	Drainage of depressions.	35,000	An anti-malaria project. Rough plans and estimates prepared.
	Delhi ...	Delhi* ...	2,06,534	8,10,343	2 8 7	Intra and extra-mural drainage. Improvements of Bela.	—	An anti-malaria project.
	Delhi ...	Ballabgarh ...	4,506	13,271	2 8 8	Intra-mural drainage.	16,600	"Quite beyond the means of Local Bodies." Note by Commissioner, Delhi Division.
	Delhi ...	Faridabad ...	5,310	7,590	1 2 1	Intra-mural drainage.	10,000	
	Karnal ...	Karnal ...	22,708	42,174	1 9 8	Extra-mural drainage.	25,000	Detailed plans and estimates approved. Grant of Rs.6,156 made by Sanitary Board.
	Karnal ...	Karnal ...	—	—	—	Intra-mural drainage.	2,000	Rough plans and estimates prepared.
	Karnal ...	Kaithal ...	14,408	21,194	1 1 4	Drainage and filling of tanks.	12,000	Under consideration. Plan and estimates not yet prepared. An anti-malaria project.
	Ambala ...	Ambala ...	26,744	83,462	2 2 1	Improvements of water-works.	23,000	Plans and estimates under preparation.
	Ambala ...	Ambala ...	—	—	—	Extension of drainage scheme in Ambala City.	10,000	Fair estimate approved by a Sanitary Engineer.
	Ambala ...	Ambala ...	—	—	—	Improvement of Rupar drainage system.	20,000	No proper estimate prepared yet.
	Ambala ...	Ambala ...	—	—	—	Storm water and sullage drainage of Jagadhri town.	14,000	Estimate under preparation.
	Ambala ...	Sadhaura ...	9,812	9,991	0 12 11	Drainage ...	17,000	Under consideration.
	Simla ...	Simla ...	14,130	5,60,693	13 3 2	Hydro-electric scheme.	—	Under construction.
	Simla ...	—	—	—	—	Additional water-supply for Simla (a part of the Simla Improvement scheme).	3,61,000	Fair estimates submitted to Local Government in the Public Works department.
	Simla ...	—	—	—	—	Extension of sewage system for the disposal of sullage at Simla.	—	Estimate under preparation by the Municipal Committee.
	Simla ...	—	—	—	—	Disposal of the Chhota, Chelsea and Sanjauli drainage.	51,000	Fair estimate approved by Sanitary Engineer.
JULLUNDUR.	Jullundur ...	Jullundur ...	54,455	83,485	1 3 0	Outfall drainage ...	10,700	Under consideration.
	Ludhiana ...	Ludhiana ...	48,211	1,26,748	1 14 4	Improvement of extra-mural drainage.	15,765	Ditto.
	Ferozepore	Ferozepore ...	23,475	64,155	2 2 3	Improvement of extra-mural drainage.	10,000	Ditto.
	Ferozepore	Muktesar ...	6,389	27,191	2 3 9	Intra-mural drainage.	14,000	Ditto.
	Ferozepore	Fazilka ...	8,505	40,610	1 14 3	Drainage ...	65,000	Under consideration.
	Kangra ...	—	—	—	—	Nurpur water-supply scheme.	21,000	Partly anti-malarial. Preliminary estimate has been approved by Sanitary Engineer.

Division.	District.	Municipality.	Population, Census 1901.	Income 1909-10.	Incidence of taxation, 1909-10.	Nature of project.	Estimate of cost.	REMARKS.
								<i>Note.</i> —All projects except those marked with an asterisk are included in Divisional Statements of Sanitary Projects to be carried out in 5 years from 1910.
LAHORE.	Lahore ...	Lahore ...	1,86,884	Rs. 9,21,351	Rs. a. p. 3 2 9	Sewerage scheme ...	Rs. 13,00,000	Plans and estimates under preparation.
	Lahore ...	—	—	—	—	Conversion of Bach channel of Ravi into ornamental water with proper outfall and constructing proper Dhobi Ghat.	20,000	Under consideration.
	Lahore ...	—	—	—	—	Sharakpur drainage scheme.	15,000	Rough estimate approved by Sanitary Engineer.
	Lahore ...	Kasur ...	22,022	62,066	2 1 6	Intra and extra-mural drainage.	32,500	Under consideration.
	Amritsar ...	Amritsar ...	1,61,039	6,58,243	2 0 11	Sewage disposal works.	59,000	Under consideration. Rs.54,414 have been allotted by the Sanitary Board.
	Amritsar ...	—	—	—	—	City sewage ...	2,55,000	Under preparation. All anti-malarial. The Lieutenant Governor has given Rs.1,00,000 for buying tanks and Rs.1,40,000 for filling them.
	Amritsar ...	—	—	—	—	Civil Lines drainage	15,000	Under consideration.
	Amritsar ...	—	—	—	—	Filling up of tanks	95,000	Plans and estimates prepared.
	Amritsar ...	—	—	—	—	Water-supply ...	45,000	Under consideration.
	Amritsar ...	Taran Taran	4,428	11,454	2 0 11	Drainage ...	7,567	Under preparation.
	Gurdaspur...	Gurdaspur ...	4,903	9,749	1 2 9	Drainage ...	8,045	Under consideration.
	Gurdaspur...	Batala ...	27,365	57,047	1 4 6	Drainage and filling of tanks.	11,124	Under consideration. Partly an anti-malaria project.
	Gurdaspur...	—	—	—	—	Drainage works for Khajini and Purian Gates area at Batala.	5,000	Estimate under preparation.
	Gurdaspur...	Dalhousie ...	808	25,781	8 13 0	Improvements to water supply.	7,000	No information.
	Sialkot ...	Sialkot ...	44,789	1,65,384	2 5 1	Intra-mural drainage	50,000	Returned by Sanitary Board for revision. Rough project approved by Sanitary Engineer.
	Sialkot ...	—	—	—	—	Water-works ...	4,28,000	The wells sunk and estimates under consideration.
	Sialkot ...	—	—	—	—	Drainage scheme for the neighbourhood of railway station at Sialkot.	21,000	Rough project approved by Sanitary Engineer.
	Gujranwala	Gujranwala	28,356	81,781	2 1 2	Intra-mural drainage	15,000	
	Gujranwala	Wazirabad ...	18,069	32,641	1 6 4	Water-works ...	—	No information.
	Gujranwala	Wazirabad ...	—	—	—	Intra and extra-mural drainage.	—	
	Gurat ...	Jalalpur Jattan.	10,640	14,865	1 3 2	Drainage scheme (sullage).	4,800	Under consideration.
	Jhelum ...	Jhelum ...	11,703	51,213	2 14 4	Intra-mural drainage, northern section.	10,000	Under preparation.
	Shahpur ...	Jhelum ...	—	—	—	Khushab water-supply.	—	Experiment yet in hand. Trial wells being sunk. Estimate depends on result.
	Shahpur ...	Jhelum ...	—	—	—	Extra-mural drainage works for Bhera.	18,000	Project under preparation.
	Shahpur ...	Jhelum ...	—	—	—	Drainage scheme for Miani.	10,000	No proper estimate prepared as yet.
	Rawalpindi	Rawalpindi...	47,077	2,41,972	3 3 8	Intra-mural drainage	1,69,398	Plans and estimate complete. Project pending owing to defect in extra-mural drainage.
RAWALPINDI.	Rawalpindi	Rawalpindi...	—	—	—	Extension of water-supply at Rawalpindi.	—	No project prepared yet.
	Rawalpindi	Murree ...	1,517	69,269	5 0 11	Intra-mural drainage	28,515	Under consideration but project delayed for want of funds. Sanitary Board has allotted Rs.7,000.
	Attock ...	Hazro ...	9,799	31,081	1 10 4	Protection of bund	6,000	Under consideration.
	Attock ...	Hazro ...	—	—	—	Sullage farm ...	4,000	Under consideration. This is part of a drainage (sullage scheme) costing Rs.14,181, now under consideration, to which the Sanitary Board has made a grant of Rs.8,000.

Division.	District.	Municipality.	Population, Census 1901.	Income 1909-10.	Incidence of taxation, 1909-10.	Nature of project.	Estimate of cost.	REMARKS.
								<i>Note.</i> —All projects except those marked with an asterisk are included in Divisional Statements of Sanitary projects to be carried out in 5 years from 1910.
MULTAN.	Mianwali ...	Isakhel* ...	7,630	Rs. 8,044	R. a. p. 1 13 1	Water-works ...	Rs. 32,896	Plans and estimates under preparation.
	Mianwali ...	Isakhel ...	—	—	—	Drainage scheme for the town of Mianwali.	18,960	Rough project approved by Sanitary Engineer.
	Lyallpur ...	Lyallpur* ...	9,171	1,14,889	1 1 2	Extension of drainage (sullage).	30,378	Scheme approved and forwarded to Government for sanction.
	Lyallpur ...	Lyallpur ...	—	—	—	Extension of water-works.	24,384	Detailed plans and estimates approved.
	Lyallpur ...	Lyallpur ...	—	—	—	Provision of water-tower.	13,910	Plans and estimates forwarded to the Superintending Engineer, 1st Circle, for disposal. Board have no objection to scheme.
	Lyallpur ...	Lyallpur ...	—	—	—	Water-supply for Chiniot Road town.	—	Estimate under preparation.
	Lyallpur ...	Lyallpur ...	—	—	—	Improvement of water-supply at Gojra.	60,037	Estimate approved by Sanitary Engineer and submitted for sanction.
	Jhang ...	Jhang ...	23,198	56,363	1 15 2	Outfall drainage ...	7,000	Under consideration.
	Jhang ...	Chiniot ...	15,685	30,585	1 9 11	Intra and extra-mural drainage.	59,783	Fair project for the whole town prepared and approved by the Sanitary Engineer and sanctioned by the Local Government. It was abandoned for want of funds.
	Jhang ...	—	—	—	—	Provision of flushing arrangements at Maghiana.	12,200	No proper estimate prepared as yet.
	Multan* ...	Multan ...	74,627	2,10,731	2 6 5	Water-works ...	—	Case sent to Sanitary Engineer on 14th December 1910 by Sanitary Board.
	Multan ...	Shujabad ...	5,880	19,339	2 11 4	Intra and extra-mural drainage.	5,117	Plans and estimates sent to Executive Engineer for disposal.
	Muzaffargarh	Muzaffargarh	3,737	13,404	2 2 1	Drainage scheme ...	6,385	Rs.4,000 allotted by Sanitary Board.
	Dera Ghazi Khan.*	Dera Ghazi Khan.	21,697	63,284	2 9 3			
	Dera Ghazi Khan.*	Dera Ghazi Khan.	—	—	—	Chorutta water-supply.	—	Estimate under preparation.
	Dera Ghazi Khan.*	Dera Ghazi Khan.	—	—	—	Chorutta drainage works.	—	No project prepared yet.
	Dera Ghazi Khan.	Dajal ...	6,213	12,473	1 13 8	Water-works ...	6,000	Under consideration.
	Montgomery	Montgomery	—	—	—	Drainage scheme for Pakpattan.	25,000	No proper estimate prepared as yet.

From G. B. H. Fell, Esq., C.I.E., I.C.S., Officiating Secretary to the Government of Burma, Municipal Department, to the Secretary to the Government of India, Department of Education, No. 508-M.—1-Medl., dated the 22nd September, 1911.

I am directed to acknowledge the receipt of your letter No. 1543, dated the 21st August, 1911, on the subject of a Conference of Sanitary Commissioners to be held at Bombay at the end of October or the beginning of November.

2. I am to explain that Major C. E. Williams, I.M.S., Sanitary Commissioner, Burma, is at present on leave, and will return in November too late to attend the Conference. On relief by Major Williams, the Officiating Sanitary Commissioner, Major S. A. Harriss, I.M.S., will revert to his substantive appointment of Deputy Sanitary Commissioner in the United Provinces. The Lieutenant-Governor does not consider that there would be any advantage in deputing him to attend the Conference, since any knowledge he might acquire from the discussions would not be at the disposal of this Government, whose service he would be leaving immediately after the Conference. His Honour has therefore deputed Major N. P. O'Gorman Lalor, I.M.S., Deputy Sanitary Commissioner, who is at present on special duty in connection with the study of malaria, and who will also attend the annual meeting of the General Committee for the study of malaria. Major Lalor has been instructed to comply with the orders contained in paragraph 3 of your letter, and to communicate to the Sanitary Commissioner with the Government of India at the earliest possible date the subjects which he proposes for discussion.

3. With reference to paragraph 5 of your letter I am to submit that His Honour has considered the possibility of deputing the Sanitary Engineer, Burma, with such schemes of urban sanitation as have already been prepared; but as the present incumbent is retiring just before the date of the

Conference, and his successor will not have had time to bring himself into touch with the requirements of the province, the idea has been abandoned. The preparation of a definite programme of urban sanitation extending over a series of years will be taken in hand without delay, but His Honour regrets that it is impossible to have the report ready in time for this year's Conference.

From the Honourable Mr. W. J. Reid, I.C.S., Financial Secretary to the Government of Eastern Bengal and Assam, Shillong, to the Secretary to the Government of India, Department of Education, Simla. No. 6197-M., dated the 21st September, 1911.

(Extract.)

The Government of India have asked for the submission of a report on definite schemes of urban sanitation which will extend over a series of years indicating the degree of urgency and the amount of financial assistance required to carry them out within a reasonable period and steps are being taken to compile the necessary information. The number of such schemes in this province is very large, but the only two which need for the present be separately mentioned are the Dacca sewerage scheme which is estimated to cost 13 lakhs of rupees and the Dacca drainage scheme which is estimated roughly to cost something like 50 lakhs. For the former scheme a detailed project is being prepared. The time within which the former of these schemes can be carried out will depend on the possibility of taking it up in compartments.

From the Honourable Mr. W. J. Reid, I.C.S., Financial Secretary to the Government of Eastern Bengal and Assam, Municipal Department, to the Secretary to the Government of India, Department of Education. No. 6506-M., dated the 17th October, 1911.

I am directed to invite a reference to paragraph 5 of my letter No. 6197-M., dated the 21st September, 1911, in which it was stated that steps were being taken to compile a report on definite schemes of urban sanitation which would extend over a series of years. I am further to invite a reference to Mr. Kershaw's telegram No. 32, dated the 23rd January, 1911, which mentioned several urgent projects and to Mr. Porter's letter No. 353, dated the 3rd March, 1911, sanctioning a special non-recurring grant of Rs.9,00,000 for expenditure on urban sanitary works in Eastern Bengal and Assam.

2. As already observed the number of such schemes in the province is very large, and, while progress has of late been comparatively rapid owing to the generous financial assistance given by the Government of India, the Lieutenant-Governor could utilise to the full almost any amounts which might be available. Time does not permit of an exhaustive list of the sanitary requirements of the province being compiled before the next Conference of Sanitary Commissioners, but a brief note is appended giving details of the most important schemes which His Honour would wish to undertake at the earliest possible moment but which must in default of assistance from the Government of India in some cases stand over indefinitely and in others be spread over a lengthy period of years. All these schemes are essentially necessary, but the Lieutenant-Governor regards the Dacca sewerage scheme, the Chittagong water-supply scheme and the Jorhat water-supply scheme as the most urgent.

3. As the Sanitary Commissioner in Eastern Bengal and Assam will attend the forthcoming Conference and is, as Secretary to the Sanitary Board, well acquainted with the various projects described in the note, Sir Charles Bayley trusts that the somewhat meagre information now given may suffice for the consideration of the Conference.

NOTE.

Dacca sewerage scheme.—This is a scheme for carrying off house sewage and sullage in underground sewers and treating it in septic tanks and percolating filters. A rough project has been prepared and two expert engineers have been engaged to work out a detailed project. The estimated cost of the scheme is Rs.13,00,000 and a beginning will be made with it next year, if, as is hoped, it is found possible to undertake the work in compartments. It is improbable that the Dacca Municipality will be able to do more than meet the maintenance charges and it is proposed to finance the first instalment from the non-recurring grant of Rs.9,00,000 made by the Government of India.

Dacca drainage scheme.—This is an ambitious but very necessary scheme for improving the *khals* in the town of Dacca and carrying storm water surface drainage and sub-soil drainage into them through surface drains. The channels will have to be cleared and deepened and the silt removed will be used to raise low-lying portions of the town. The result will be the reclamation of a considerable area of valuable land in Dacca, but, apart from the cost of the scheme which is roughly estimated at Rs.50,00,000, the question of the ownership of these channels is by no means free from difficulty. Special enquiries into this question are being made by the Settlement Department, but it may be necessary before this scheme is actually undertaken to consider the advisability of the creation of a Dacca Improvement Trust somewhat on the lines of but on a much smaller scale than the Calcutta Improvement Trust.

Chittagong water-supply.—It has been estimated that the cost of a proper water-supply for Chittagong will be about Rs.4,00,000 and Rs.70,000 has already been expended by this Government in boring and maintaining three artesian wells. The water obtained is plentiful but is chalybeate, and special experiments are being made with a view to the removal of the taste. The Chittagong Municipality can contribute towards the cost of the scheme but the major portion will have to be found by the local Government. The scheme is one which His Honour would gladly see undertaken.

Shillong drainage scheme.—A scheme has been prepared for the removal of sewage and sullage by means of underground sewers and a detailed project is under preparation. The cost is estimated to be Rs.11,00,000.

Silchar water-supply.—A project estimated to cost Rs.1,00,000 is under preparation. The municipality proposes to borrow Rs.40,000 and to ask Government for a grant of the balance.

Jorhat water-supply.—A detailed project for both a water-supply and the improvement of the drainage of the new civil station has been prepared, the estimated cost being Rs.1,10,000. The municipality is a small one and can contribute very little towards the cost which must be borne almost entirely by the local Government.

From Lieutenant-Colonel R. P. Colomb, I.A., Second Secretary to the Chief Commissioner, Central Provinces, to the Secretary to the Government of India, Education Department. No. 1832-VI—14-36, dated the 20th October 1911.

I am directed to refer to your letter No. 1545, dated the 21st August 1911, in connection with the ensuing Conference of Provincial Sanitary Commissioners to be held at Bombay, and in reply to paragraph 5 thereof, to forward herewith for the information of the Government of India two statements showing drainage and water works schemes—

- (i) which have been completed,
- (ii) which are under construction,
- (iii) which are under survey,
- (iv) other works which are contemplated but not yet surveyed.

2. I am to say that Mr. Craddock considers that in order to combat disease, water works and drainage must go hand in hand. The former cannot be unduly protracted, but the latter can be spread out over a fair number of years. These works should also be accompanied by gradual demolition of existing site-crowded areas and by timely provision for the sanitary extension of towns which are growing or are expected to grow on account of the construction of new railways. The system being followed in the Central Provinces is one of preparation of really sound projects before any money is spent. The financing of the schemes by the Municipalities concerned has been arranged on the basis of half loan and half grants from Provincial revenues. At present the annual expenditure on sanitary works will be roughly 2 lakhs from loans and the same amount from Government grants or a total of 4 lakhs a year, but this amount might easily be doubled if the Government of India are pleased to increase the Imperial grant for sanitation. Some of the towns, however, will not be able to borrow even half the sum required to finance their schemes, and in their cases, provided the taxation is full, Government aid might be extended so as to cover $\frac{2}{3}$ of the cost, but beyond this Mr. Craddock is not prepared to go.

3. Extensions for growing towns are among the most urgent requirements, and in these cases a good part, if not all the cost, is recovered from premia and rents on sites disposed of. Demolition of site-crowded areas has to proceed more slowly, but is a very useful and effective method of reducing disease. Improvement in general health from air and good drainage is, in Mr. Craddock's opinion, a very potent factor for combating the chief epidemic diseases.

4. The Chief Commissioner believes that the policy now being followed in the Central Provinces is thoroughly sound and will not, he hopes, be changed though the rate of progress is mainly a question of funds and supply of labour.

I.—Statement showing drainage schemes in Central Provinces.

Name of town.	Population according to Census of 1911.	Amount expended or required (total) to be expended for survey of schemes.	Probable cost of schemes.	REMARKS.
(1) <i>Works completed.</i> <i>Nil.</i>		Rs.	Rs.	
(2) <i>Works under construction.</i> Nagpur sewage scheme ...	134,712	55,000	35,51,250	Of this work to the extent of Rs.16 lakhs has been sanctioned. Work is to be completed in 8 years ending 1917-18 having an allotment of two lakhs each year (one lakh from loan and one lakh by Government grant). Preliminary arrangements have been made for the manufacture of materials, and the manufacture is now in progress. Construction will be begun shortly.
Wardha surface drainage scheme.	12,540	1,000 (Revision only).	2,04,670	Estimate sanctioned. Work to the extent of Rs.1,92,997 will be completed in three years ending 1913-14. Government grant one lakh and Rs.92,997 from loan have been arranged. Arrangements will be made to start work shortly.
(3) <i>Schemes surveyed and under survey.</i> Akola surface drainage scheme.	27,161	10,000	4,39,940	A complete project has been prepared by Messrs. Lane Brown and Hewlett for the surface drainage of this town. The Municipality are considering the arrangements for financing the work.
Khamgaon surface drainage scheme.	13,182	5,500	2,79,976	A complete project for the surface drainage of this town has been prepared by Messrs. Lane Brown and Hewlett. The question of financing the scheme has not yet been considered.

I.—Statement showing drainage schemes in Central Provinces—continued.

Name of town.	Population according to Census of 1911.	Amount expended or required (total) to be expended for survey of schemes.	Probable cost of schemes.	REMARKS.
(3) Schemes surveyed and under survey—cont.		Rs.	Rs.	
Jubbulpore sewage scheme ...	100,651	25,000 subject to change in population.	13,08,463 probable	The preparation of the project is in the hands of Messrs. Lane Brown and Hewlett. A Government grant of Rs.10,000 was made for the survey last year, and Rs.15,000 from the same source this year.
Bhandara surface drainage scheme	7,414	3,700	96,382	A Government grant of Rs.3,700 has been made this year for preparing the project, which work has been entrusted to Messrs. Lane Brown and Hewlett.
Burhanpur surface drainage scheme	30,435	5,500 (Revision only.)	3,95,655	The preparation of project sanctioned and its preparation is being carried out by Messrs. Lane Brown and Hewlett. A Government grant of Rs.5,500 has been made for this work.
Khandwa surface drainage scheme	21,604	4,250 (Revision only.)	2,80,852	The preparation of the project has been sanctioned and is being carried out by Messrs. Lane Brown and Hewlett. A Government grant of Rs.4,250 has been made for the purpose.
Harda surface drainage scheme ...	8,341	3,500 (Revision only.)	108,433	The preparation of the project has been sanctioned; it is carried out by Messrs. Lane Brown and Hewlett. A Government grant of Rs.3,500 has been made for the work.
Itarsi surface drainage scheme ...	4,430	1,760 (Revision only.)	57,590	Preparation of project sanctioned. Messrs. Lane Brown and Hewlett carrying out survey. A Government grant of Rs.1,750 has been made.
(4) Schemes contemplated but not yet surveyed.				
Seoni surface drainage scheme ...	13,839	3,460	1,79,907	The Commissioner is considering whether it will be possible for the municipality to finance this scheme in the near future. His final reply is awaited before further steps are taken.
Raipur surface drainage scheme ...	35,335	7,000	4,59,355	The question as to the ability of the municipality to finance the work in the near future is under consideration by the Commissioner before surveys are begun.
Bilaspur surface drainage scheme...	19,850	4,000	2,58,050	The ability of the municipality to finance the work in the near future is being considered by the Commissioner before the preparation of the project is begun.
Amraoti surface drainage scheme...	40,610	10,153 probable.	5,27,930	The Commissioner is considering the question of the ability of the municipality to finance the project in the near future before the surveys are begun.
Saugor surface drainage scheme ...	45,908	11,477	5,96,804	Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present.
Arvi surface drainage scheme ...	11,902	2,976	1,54,726	Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present.
Hinganghats surface drainage scheme	14,943	3,736	1,94,259	Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present.
Umrer surface drainage scheme ...	17,630	4,408	2,29,190	Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present.
Karanja surface drainage scheme...	12,852	3,213	1,67,076	Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present.

II.—Statement showing water-works scheme in Central Provinces.

(1) Works completed.		Rs.	Rs.	
Nagpur water-works ...	134,712	...	...	A gravitation scheme with a pumping high level extension exists. Another combined storage and pumping scheme has just been added, vide item I of 1911.
Bhandara water-works ...	7,414	...	...	A pumping scheme from wells.
Jubbulpore water-works ...	100,651	...	...	A gravitation scheme recently improved.
Seoni water-works ...	13,839	...	...	A gravitation scheme. A new iron main has just been laid.
Burhanpur water-works ...	30,435	...	...	A gravitation scheme.
Raipur water-works ...	35,355	...	...	Pumping scheme from infiltration galleries and wells.
Rajnandgaon water-works...	11,979	...	...	Ditto ditto ditto.
Buldana water-works ...	3,820	...	...	Pumping scheme from a storage tank.
Khamgaon water-works ...	13,182	...	...	A gravitation scheme.

II.—Statement showing water-works scheme in central Provinces—continued.

Name of town.	Population according to Census of 1911.	Amount expended or required (total) to be expended for survey of schemes.	Probable cost of schemes.	REMARKS.
(1) Works completed—cont.		Rs.	Rs.	
Wardha water-works	12,540	...	...	The question of improvement to this scheme is under consideration.
Khandwa water-works	21,604	...	...	A proposal for increasing the supply by feeding the existing reservoir from the proposed Taimber irrigation tank, is being investigated.
Amraoti water-works	40,610	...	...	Extensions contemplated and project under investigation.
Akola water-works	27,161	...	...	Ditto ditto ditto.
(2) Works under construction.				
Nagpur water-works	134,712	...	10,00,000	A new storage reservoir at Gorewara with a pumping scheme from it is under construction and practically finished at a cost of Rs.10 lakhs. The work is nearly completed. This is in addition to the existing water-works at Ambajheri. Government grant Rs.2½ lakhs.
Hinganghat water-works	14,943	...	22,887 estimated.	Estimate for improvements sanctioned from Municipal funds and work begun.
Harda water-works	8,341	...	...	Improvements at a cost of Rs.1,20,000 from Municipal funds practically finished.
(3) New schemes contemplated and under survey.				
Arvi water-works	11,902	...	...	Sanction given for the preparation of a project and an amount of Rs.1,378 as Government grant given to the Municipal Committee for its investigation.
(4) New schemes under contemplation but no survey undertaken.				
Chanda water-works	19,366	...	...	Schemes proposed. The possibility of the municipalities financing the schemes is being considered by the Commissioner before the investigations are carried further. The Commissioner's reports are awaited.
Saugor water-works	45,908	...	...	
Damoh water-works	17,042	...	...	An estimate amounting to Rs.197 for the preparation of a project was received but returned to Superintending Engineer, I Circle, for record as sufficient number of projects have been undertaken in the Nagpur Civil Division for the present.
Balaghat water-works	7,400	...	...	

APPENDIX 2 to No. 4.

Note on Municipal Water-supply and Drainage Schemes in the Bombay Presidency, including Sind but excluding Bombay City and Aden.

1. The following is a brief review of the progress of water-supply and drainage works in municipal towns in this Presidency. The City of Bombay, Military Cantonments, and all inhabited areas not enjoying municipal franchise are excluded from this review.

2. The total number of municipalities in the Presidency is 157, with a population of 2,351,829 out of a total of 19,618,687 for the whole of the Presidency. Out of these only 17 towns have a properly distributed piped supply, and about 30 more have an imperfect supply capable of considerable improvement. The population of these towns is 1,671,000, and the capital outlay on water-works per head works out to Rs. 4.6.

3. Only two cities, Ahmedabad and Karachi, have drainage installations on modern lines, and the sewerage of Poona City is in progress.

4. The Sanitary Board as at present constituted and consisting of—

The Surgeon-General with the Government of Bombay	...	...	as President
The Commissioner, Central Division...	...	...	as Members
The Chief Engineer, Public Works Department	...	...	
The Sanitary Commissioner for the Government of Bombay	...	...	
The Sanitary Engineer to Government, Bombay	...	...	as Member and Secretary

was formed in 1902 to advise Government upon all general questions of policy and on large individual schemes of sanitary improvement. The functions of the Board have hitherto been advisory, but the time has come to consider if some of the powers of Government may not be delegated to it so that Government may be relieved of much work of minor importance.

5. Whatever progress was made in the past in regard to the provision or improvement of water-supply has been chiefly due to the initiative of Collectors, assisted by Engineer officers and a few enthusiasts in the cause of sanitary reform. Very few municipalities were in a position to

spend money on new schemes, and when they were willing to do so they had not the necessary establishment for the preparation of plans and estimates, and very few had the means to undertake such works without substantial assistance from Government. The average capital expenditure on water-supply and drainage in mofussil municipalities during the six years ending 1896-97 was 6.38 lakhs of rupees annually. In the next seven years it fell to 2.18 lakhs, and the total capital outlay on water-supply was as low as Rs. 3.26 per head of population in municipal areas. If large cities like Ahmedabad and Surat were excluded, the capital outlay on sanitary works in municipal towns was merely nominal. This stagnation in municipal enterprise was brought to the notice of Government by the Sanitary Board in 1905, and Government were pleased in 1907 to pass liberal orders for securing greater progress in sanitary improvement in municipal and local board areas. Under these orders the execution of all surveys, as well as the preparation of detailed plans and estimates, was entrusted to the establishment working under the Sanitary Engineer, the cost of such establishment being considered as a Government grant-in-aid to the progress of sanitary improvement in the Presidency. Desirable schemes, approved by the Sanitary Board, but which are beyond the financial powers of municipalities or other local bodies, will receive assistance, both by loans and grants-in-aid, subject to a limit in the latter case of 50 per cent. of the total estimated cost of the undertaking, provided that Government is convinced that the local bodies concerned shew their willingness to make proper efforts to help themselves. This generous assistance from Government has given a great impetus to sanitary measures, and there is no doubt that substantial progress may be looked for in future. There is already a great awakening, and requests for the preparation of suitable sanitary schemes, particularly those in connection with water-supply and drainage, are coming in from several municipalities, and the Sanitary Engineer's establishment is fully engaged in maturing projects.

6. *Statement I* shews the water-supply and drainage works executed by municipalities previous to 1907 without any special grant-in-aid from Government.

Statement II shews the sanitary works sanctioned after 1907 and now in progress.

Statement III shews projects, the estimates for which are ready for submission to Government.

Statement IV shews schemes that have been drawn up, but which have not yet been approved by the Sanitary Board pending the settlement of the question of the manner in which they are to be financed.

Statement V shews the sanitary works that will probably be executed during the next ten years, together with the grants-in-aid that are likely to be sanctioned by Government.

7. The daily rate of water-supply provided for varies from 15 to 30 gallons per head per day in the case of large towns and cities, and in most of the smaller ones it is from 5 to 15 gallons only. The actual consumption in the case of large cities has already exceeded the provision made, and as the population increases and new drainage schemes are introduced, or old ones extended, there will be more demand for water in a few years. In the case of smaller towns also, the introduction of drainage systems of some sort will soon become necessary, and the existing water-supplies will be found defective and unsatisfactory and schemes for their improvement will soon become an urgent necessity.

8. In Guzerat the question of water-supply in many places is difficult and urgent. The water available is scanty and brackish. Surface catchment is usually out of the question, owing to contamination by salt in the surface soil. Shallow wells are also impracticable, for the same reason and on account of contamination from sewage and cultivation. There is, however, every likelihood of a good underground supply being tapped. Almost everywhere in Guzerat there is a fairly good sub-artesian supply, and there is a strong belief that if borings are made deep enough even artesian supplies may be met with. Corroboration of the existence of sub-artesian supplies is obtained from the result of a few moderately deep bores that have been already made. The presence of sub-artesian supplies at two places like Broach and Sanand 123 miles apart is sufficient to justify the sinking of numerous borings in Guzerat. The Bombay, Baroda and Central India Railway have recently made a successful boring in the Viramgaom, and it is reported that the Railway Company have now an abundant supply of good water. Details about this boring are now being collected.

Government have purchased six complete plants for making borings 3 to 12 inches in diameter and 250 to 2,000 feet deep at a cost of Rs. 1,15,000. Part of the plant has just been received, and a special Boring Engineer has been engaged. Work will soon be commenced at Broach, Dakor, Nadiad, Nandurbar, Borsad, Sabarmati, Viramgaon and Kharaghoda. At Dholka a 5-inch bore, 124 feet deep, has been made, and a good sub-artesian supply of sweet water has been tapped. Water is being pumped up, but chemical analyses shew that it may have to be filtered. The annual expenditure on deep boring will be about Rs. 50,000, and in a couple of years it will be settled once for all if sub-artesian supplies will offer a satisfactory practicable solution of the water difficulty in Guzerat.

9. *Large drainage works.*—At Ahmedabad over half of the city has been properly sewered. The sewage flows by gravitation to a pumping station, from which place it is pumped up into a sewage main and brick outfall sewer on to a sewage farm of 351 acres. The total population now served is 90,000 only, and the cost of the works up to date has been about 14.9 lakhs of rupees. The complete scheme aims at sewerage a population of 150,000 at the rate of 30 gallons per head per diem, but as the population of Ahmedabad is now 216,000, owing to increased activity in mill industry, and as the consumption of water is greater than the sewers were originally designed to carry, the sewerage scheme will probably have to be supplemented in the near future with an additional main sewer to accommodate the extra supply.

At Karachi the Shone system of drainage is in use, and serves a population of 44,600 out of a total of 159,270. The total outlay to date is 11.5 lakhs of rupees. The rising main ends in a sewage farm of 115 acres, of which 50 to 60 acres are under sewage irrigation.

At Poona the works are in progress and are somewhat similar to those at Ahmedabad. The sewage is supposed to be treated in a septic tank. Interesting experiments are being conducted by an officer specially deputed for the purpose, and a sum of Rs. 27,000 will be allotted for the

expenditure required. The experimental sewage installation is on a fairly large scale, and the objects which it is hoped to attain from it are generally as follows :—

- (a) to ascertain the optimum period of stay in a septic tank for sewages of various strengths,
- (b) to ascertain if this period can be shortened economically by use of other means, such as hydrolytic chambers or macerating tanks or colloids,
- (c) to find to maximum amount of suspended matter in the tank effluent which can be efficiently dealt with by different forms of filtering material without clogging,
- (d) to ascertain the proportion of nitrates in the filter effluent and the methods of treatment which will give the maximum quantity of nitrates, and
- (e) to ascertain how far skilled supervision can be dispensed with in small installations.

It is expected that the results of these experiments which are the first of their kind in India and which will give reliable data for the designing and efficient working of installations for the disposal of sewage by the bacterial method in this country in future will become available before December 1912.

10. The duties of the Sanitary Engineer have so far been that of a consulting officer ; he has only two large sanitary works under his direct supervision—the Pandharpur water-works and the Poona drainage and water-supply (improvements).

In addition to inspections, responding to consultations and preparing plans and estimates for important sanitary projects it is scarcely possible for the Sanitary Engineer to undertake the *execution* of works also. As calls increase it will be necessary to adequately increase his establishment to enable him to get up projects quickly and judging from the present experience of the amount of work he has to get through it is likely that the Sanitary Engineer will ever remain as a consulting officer. Works are necessarily conducted by Executive Engineers in charge of districts. Ordinarily Executive Engineers may not experience much difficulty in carrying out small sanitary schemes from designs and specifications furnished by the Sanitary Engineer, but it is the execution of details in both water-supply and sewerage works that success of the schemes depends, and the necessity of having such works executed under special expert supervision may soon become apparent.

(Signed) N. BELVADI,
Sanitary Engineer to Government, Bombay.

POONA ;
The 6th November 1911.

STATEMENT No. I.

Sanitary Works executed..

No.	Name of Works.	Total expenditure incurred.	REMARKS.
NORTHERN DIVISION.		Rs.	
1	Ahmedabad water-supply	8,95,166	
2	Surat do.	9,97,229	
3	Rander do.	1,36,000	
4	Thana do.	85,165	
5	Bhivandi do.	35,554	
6	Ahmedabad drainage	14,20,000	
CENTRAL DIVISION.			
7	Poona City pipe distribution... ..	3,15,321	
8	Sholapur water-supply	2,17,184	
9	Ahmednagar do.	1,19,381	
10	Pandharpur do.	2,35,000	
11	Dhulia do.	4,17,000	
12	Jalgaon do.	1,70,897	
SOUTHERN DIVISION.			
13	Satara water-supply	3,69,000	
14	Hubli do.	4,88,666	
15	Pen do.	30,565	
SIND.			
16	Karachi water-supply... ..	17,29,677	
17	Hyderabad do.	4,50,000	
18	Sukkur do.	3,73,735	
19	Karachi drainage including farm	11,50,000	

(Signed) N. BELVADI,
Sanitary Engineer to Government, Bombay.

POONA ;
The 6th November, 1911.

STATEMENT No. II.

Sanitary Works in progress.

No.	Name of Work.	Estimated amount.	Government grant-in-aid.
		Rs.	Rs.
1	Sassoon Hospital sanitary improvements	13,798	13,798
2	Ahmedabad water-supply improvements	1,75,113	—
3	Ahmedabad sanitary improvements	—	50,000
4	Pandharpur water-supply works improvements	4,28,042	4,27,745
5	Pandharpur drainage	2,00,659	—
6	Improvements to Hubli water-works	5,48,189	1,99,357
7	Dharwar water-works	3,35,473	81,063
8	Nasik water-works	4,15,852	2,65,852
9	Improvements to Sholapur water-works	8,16,427	45,000
10	Improvements to Hyderabad water-works	2,95,888	58,000
11	Bijapur water-works	4,26,000	2,00,000
12	Ratnagiri water-supply	46,500	{ 16,750 15,000
13	Roha Ashtami water-supply	15,750	6,167
14	Aden water-works	—	50,000
15	Poona water-supply and drainage	17,42,023	3,25,000
16	Bhusawal drainage	—	20,820
17	Gogha water-supply	3,535	1,767
18	Kurla drainage	48,000	24,000
19	Sanitary improvements to Surat	—	50,000
20	Sanitary improvements to Ahmedabad	—	50,000
21	Sanitary improvements to Belgaum	—	53,022
22	Sanitary improvements to Hubli	—	50,000

(Signed) N. BELVADI,

Sanitary Engineer to Government, Bombay.

POONA ;

The 6th November, 1911.

STATEMENT No. III.

Sanitary Works Projects—estimates for which are ready for submission to Government.

No.	Name of Work.	PROPOSED.			REMARKS.
		Amount of estimate.	Grant-in-aid recommended by the Sanitary Board.	Loan recommended by the Sanitary Board.	
		Rs.	Rs.	Rs.	
1	Igatpuri water-supply	1,14,894	40,000	75,000	
2	Karad do.	1,81,400	90,700	90,700	
3	Lonavla do.	3,72,401	1,60,000	2,00,000	
4	Barsi do.	4,72,788	2,30,000	2,30,000	
5	Malegaon do.	1,93,000	1,00,000	90,000	
6	Improvements to Dhulia water-supply	62,000	30,000	—	

(Signed) N. BELVADI,

Sanitary Engineer to Government, Bombay.

POONA ;

The 6th November, 1911.

STATEMENT No. IV.

Schemes drawn up but not yet approved by the Sanitary Board pending the question of the manner in which they are to be financed.

No.	Name of Work.	Estimated amount.	REMARKS.
		Rs.	
1	Thana water-supply	2,48,262	
2	Matheran do.	1,44,897	
3	Bulsar do.	3,50,000	
4	Parola do.	1,40,000	
5	Yeola (Khirdisate) water-supply	4,78,000	
6	Nandurbar water-supply	1,71,512	
7	Godhra do.	2,00,000	
8	Sholapur sewerage	9,57,810	
9	Nasik do.	4,54,856	
10	Thana do.	84,548	
11	Belgaum City and Cantonment sewerage	7,77,098	
12	Surat sewerage	18,17,000	
13	Dhulia do.	1,63,000	
14	Bandra do.	4,63,000	

(Signed) N. BELVADI,

Sanitary Engineer to Government, Bombay

POONA ;

The 6th November, 1911.

STATEMENT NO. V.

List of sanitary works contemplated in the Bombay Presidency showing the amounts that are likely to be spent on them during the next ten years.

Serial No.	Name of project.	District.	Rough estimate of costs of contemplated projects.	Amounts of grants-in-aid.										Remarks
				1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.	
			Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
1	Malegaon water-supply ...	Nasik ...	2,00,000	20,000	30,000	50,000	—	—	—	—	—	—	—	
2	Yeola water-supply ...	Do. ...	3,50,000	30,000	50,000	70,000	25,500	—	—	—	—	—	—	
3	Dhulia water-supply improvements	West Khandesh...	1,00,000	25,000	25,000	—	—	—	—	—	—	—	—	
4	Do. town drainage	Do.	2,00,000	20,000	30,000	50,000	—	—	—	—	—	—	—	
5	Parola water-supply ...	East Khandesh...	1,50,000	10,000	20,000	20,000	25,000	—	—	—	—	—	—	
6	Jalgaon drainage	Do.	2,50,000	10,000	15,000	20,000	25,000	30,000	25,000	—	—	—	—	
7	Dholka water-supply	Ahmedabad	50,000	5,000	5,000	10,000	5,000	—	—	—	—	—	—	
8	Surat sewerage ...	Surat ...	20,00,000	50,000	1,00,000	1,00,000	1,00,000	1,00,000	2,00,000	2,50,000	1,00,000	—	—	
9	Dakor water-supply	Kaira ...	2,00,000	5,000	45,000	50,000	—	—	—	—	—	—	—	
10	Jalgaon do.	East Khandesh...	30,000	30,000	—	—	—	—	—	—	—	—	—	
11	Faizpur sanitary improvements	Do.	30,000	30,000	—	—	—	—	—	—	—	—	—	
12	Karad water-supply	Satara ...	2,00,000	25,000	50,000	25,000	—	—	—	—	—	—	—	
13	Barsi do.	Sholapur	4,75,000	25,000	50,000	50,000	62,500	50,000	—	—	—	—	—	
14	Sholapur do.	Do.	3,25,000	45,000	—	—	—	—	—	—	—	—	—	
15	Alibag do.	Kolaba ...	26,500	13,250	—	—	—	—	—	—	—	—	—	
16	Lonavla do.	Poona ...	17,50,000	25,000	50,000	50,000	25,000	—	—	—	—	—	—	
17	Poona drainage and water-supply	Do. ...	{ 5,50,000	2,75,000	3,00,000	1,75,000	—	—	—	—	—	—	—	
18	Pandharpur water-supply	Sholapur	—	2,475	—	—	—	—	—	—	—	—	—	
19	Nasik do.	Nasik ...	—	96,852	—	—	—	—	—	—	—	—	—	
20	Nandurbar do.	West Khandesh...	2,00,000	—	20,000	30,000	50,000	20,000	30,000	—	—	—	—	
21	Bhusawal water-supply	East Khandesh...	2,00,000	—	10,000	20,000	20,000	25,000	—	—	—	—	—	
22	Bander town drainage	Surat ...	2,00,000	—	25,000	25,000	25,000	1,00,000	1,00,000	3,00,000	75,000	—	—	
23	Broach water-supply	Broach ...	15,00,000	—	25,000	50,000	1,00,000	50,000	1,00,000	—	—	—	—	
24	Godhra do.	Panch Mahals ...	2,00,000	—	10,000	20,000	20,000	10,000	—	—	—	—	—	
25	Dohad do.	Do.	1,00,000	—	20,000	20,000	10,000	—	—	—	—	—	—	
26	Uran do.	Kolaba ...	4,00,000	—	50,000	50,000	50,000	50,000	—	—	—	—	—	
27	Ahmednagar do.	Ahmednagar	6,00,000	—	50,000	1,00,000	1,25,000	25,000	30,000	40,000	—	—	—	
28	Nadiad do.	Kaira ...	3,00,000	—	50,000	20,000	30,000	30,000	30,000	—	—	—	—	
29	Matheran do.	Thana ...	1,50,000	—	—	25,000	25,000	25,000	—	—	—	—	—	
30	Sukkur do.	Sukkur ...	1,50,000	—	—	37,500	37,500	—	—	—	—	—	—	
31	Malegaon town drainage	Nasik ...	2,00,000	—	—	—	20,000	30,000	50,000	—	—	—	—	
32	Yeola do.	Do. ...	2,50,000	—	—	—	25,000	25,000	50,000	—	—	—	—	
33	Nandurbar do.	West Khandesh...	2,00,000	—	—	—	25,000	25,000	50,000	—	—	—	—	
34	Dakor do.	Kaira ...	1,50,000	—	—	—	25,000	25,000	25,000	—	—	—	—	
35	Godhra do.	Panch Mahals ...	1,50,000	—	—	—	25,000	25,000	25,000	—	—	—	—	
36	Islampur water-supply	Satara ...	2,50,000	—	—	—	25,000	25,000	50,000	—	—	—	—	
37	Belgaum do.	Belgaum	13,00,000	—	—	—	50,000	50,000	50,000	2,00,000	1,00,000	—	—	
38	Nipani do.	Do.	1,00,000	—	—	—	25,000	1,00,000	2,00,000	—	—	—	—	
39	Parola town drainage	East Khandesh...	50,000	—	—	—	10,000	15,000	15,000	—	—	—	—	
40	Virungaon water-supply	Ahmedabad	2,00,000	—	—	—	20,000	30,000	30,000	30,000	20,000	—	—	
41	Broach town drainage	Broach ...	10,00,000	—	—	—	1,00,000	1,00,000	1,00,000	1,00,000	2,00,000	—	—	
42	Dohad drainage ...	Panch Mahals	50,000	—	—	—	—	10,000	10,000	5,000	—	—	—	

APPENDIX 3 to No. 4.

OPENING UP OF CONGESTED AREAS.

With Rules for new Town Extension Sites and Buildings.

Under section 180 of the Madras District Municipalities Act every person wishing to construct a building must submit (a) a statement showing the dimensions of the building and the levels at which it is intended to lay the foundation and lowest floor, and (b) a statement shewing the means of ventilation and drainage and the privies which it is intended to provide.

No type design is insisted on and the result is that the owner builds the house according to his own plan which the Municipal Council, as long as it satisfies (a) and (b) of this section, approve of, or if after six weeks the license is not granted the applicant may proceed to construct the building. Under this Act the Municipal Council has no power to enforce its ruling.

This office has issued the attached rules for the guidance of Chairmen of Municipal Councils in laying out of new sites for buildings. These are now under the consideration of the local Government.

The Sanitary Engineer has drawn up a plan for a cheap native house (type design). A further improvement is under consideration to make the house rat proof. This I consider is very necessary especially in localities where congested areas are receiving attention on account of the outbreak of plague and where new town sites are being laid out to provide accommodation for the people who have been compelled to vacate their houses. The Sanitary Board has issued a type design for town extension.

No provision exists in the Act as it stands for improving already constructed houses, *e.g.*, if an entrance to a backyard for cleansing purposes is required there is no legal power to compel the owner to do this.

(Signed) W. A. JUSTICE, Captain, I.M.S.

POINTS TO BE OBSERVED IN LAYING OUT TOWN EXTENSION SITES
AND THE PLOTTING AND CONSTRUCTION OF HOUSES.

In laying out a site into house plots the following points should receive attention :—

- (1) Roads and streets should be marked out on the site and as far as possible they should be made to run straight crossing one another at right angles. The main roads should be 36' in width exclusive of lateral drains which should be $2\frac{1}{2}' \times 2'$. The secondary streets should be 24' in width exclusive of lateral drains which should be $2' \times 1\frac{1}{2}'$. The roads should be metalled all over from side to side not merely in the centre.
- (2) Conservancy lanes 8' to 10' in width should be formed along the backs of houses to enable the conservancy carts and scavengers to enter for the purpose of cleansing backyards of houses and for laying of drainage pipes in the event of the town being ultimately provided with under-ground drainage.
- (3) Impervious U shaped storm water drains without joints should be provided in streets. They should not on any account be rectangular. If built of Cuddapah slab their joints should be well cemented. The sides of the drain sloping to a U shaped bottom should be made of cement.
- (4) Storm water drains along streets should be at a distance of 3' from the outside front of house blocks.
- (5) Open masonry U shaped drains $1\frac{1}{2}' \times 1'$ should be provided on both sides of the conservancy lanes.
- (6) The formation of roads, streets and drains must form part of the scheme for laying out the site and should be taken in hand along with the execution of the scheme instead of deferring it to a future date until funds are available which may mean anything or nothing.
- (7) Suitable places for the construction of public latrines should be selected and set apart for the purpose.
- (8) Where there is no piped water-supply, places should be selected for the sinking of wells.
- (9) The site should be plotted giving size for house sites to be sold by auction. The width of the house sites should be 45' and the length 60' as a rule subject to alteration in particular cases. These plots should be sold under certain conditions which shall be definitely stated on the sale deed binding the buyer to carry them out under penalty of the sale being cancelled if the conditions are infringed.
- (10) The purchasers of the building sites shall build their houses within one year of their purchase, otherwise they will forfeit their right to property without any compensation unless the Municipal Council thinks of granting them a fresh period considering the circumstances of each case.
- (11) The sub-division of plots and the erection of more than one house in each plot should be forbidden.
- (12) Houses should be constructed with frontage facing the roads and streets.
- (13) The construction of back to back houses should be strictly prohibited. The formation of conservancy lanes as stated in (2) will prevent this.
- (14) No thatched houses or out-houses shall, under any circumstances, be allowed to be built.
- (15) The main walls of the house shall not be less than 10' high. The eaves must not be less than 8' above the plinth.
- (16) The house shall be built on a basement of at least 2' from the ground. Wherever possible the basement should be masonry or of some rat proof material.
- (17) The backyards of houses shall be provided with a gateway for municipal officers to inspect the same and for the entry of the sweeper when necessary.
- (18) The backyards should be provided with a suitable impervious bathing platform for the inmates of the house. Each house shall be provided with a latrine of a standard pattern

supplied by the municipal office. A plan of a cheap house latrine can be obtained on application to the Sanitary Engineer. The nightsoil must be capable of removal by way of the lane at the back of the house.

- (19) All the sullage and bath water of the house should be drained towards the backyard. It should pass through the wall into the municipal drain constructed in the lane behind the house. It should not be let into the storm water drain in front of the house.
- (20) Before any house is built a plan of it must be submitted to the Council for scrutiny and sanction for each building and unless the Council's sanction is obtained for the plan no house is to be commenced.
- (21) Each house must be sufficiently ventilated by providing suitable windows in each room.
- (22) All cattle yards should be flagged and properly drained.
- (23) The compound of houses should be enclosed with pucca walls.
- (24) A stringent requirement should provide that no buyer shall remove soil from his plot for building or any other purpose.
- (25) Parties wishing to purchase house sites should agree to these rules before possession of the land is given.

(Signed) W. A. JUSTICE, *Captain, I.M.S.*

APPENDIX 4 to No. 4.

SHORT NOTE ON TOWN-PLANNING IN SALSETTE ISLAND.

The Bombay Government propose to introduce shortly a Town-Planning Act for developing the Bombay suburbs in Salsette Island which adjoins Bombay on the north. Details of town-planning schemes are being worked out by a special officer deputed for the purpose and the method being followed is similar to that contained in the German Act, the *Lex Adikes*, whose principal virtues lie in obviating as far as possible the necessity of raising capital and in providing for the redistribution of existing plots so as to render them more suitable for building purposes.

The method briefly described is as follows :—

All land within the area being planned is pooled and the local authority takes all land required for roads, markets and other public sites and the remaining land is divided into suitable building plots and allotted to the original holders. The allotted plots are distributed, as far as possible, in the same proportion as the original ownership. The main portions of the allotted plots are kept, as far as possible, in the same position as the original plots so as to reduce displacements of existing holdings to a minimum. All rights in the original plots are transferred, where possible, to the allotted plots and in other cases are extinguished by cash compensation or otherwise. All expenses incidental to re-distribution and all costs of constructing roads and other works included in a scheme are obtained by a loan. Interest and sinking fund charges are met by the levy of a development tax upon owners in proportion to the individual benefits derived from the operation of the scheme. The benefit derived is found by estimating the "unearned increment" accruing to each holding on completion of the scheme. The estimate is liable to a certain amount of error, but, where the price of land is not too high, a slight error will not affect very materially the pockets of the holders.

2. The method above described may be applied to large or small schemes and to large or small areas. It can be applied to the construction of a single road or even to the mere re-arrangement of plots neighbouring an existing road, and it may be applied to a large area for the purpose of acquiring all land required for public purposes. The method has been worked out on paper for an area of about one square mile at Santa Cruz, a suburb on the Bombay, Baroda and Central India Railway about 12 miles from the Fort, Bombay, and a scheme has been tentatively drawn up which provides for the re-distribution of plots, the construction of roads and provision of lands for a park, a dispensary, a municipal office, schools, a police station and a recreation ground. The individual cost in most cases in land and cash for all these benefits is estimated to be under 30 per cent. of the present undeveloped value of a holding. A small scheme, such as the construction of a single road, can be carried out, in a year and the whole development tax can be at once levied from the holders, but for a large scheme, where some years may elapse before all constructional works are completed, a portion of the tax need only be required from owners until those works which materially better their holdings are taken in hand.

(Signed) E. G. TURNER, *I.C.S.*,
Special Officer, Salsette Building Sites.

APPENDIX 5 to No. 4.

*Note on Redistribution of Plots and Calculation of Development Tax in Town-Planning Schemes.**

* See page 229.

APPENDIX 6 to No. 4.

TOWN-PLANNING.

I may think that there is one direction in which the functions of municipalities might most usefully be extended, which has not been touched on by the Decentralization Commission—and this is by giving them power to frame and carry out town-planning schemes for growing towns.

Town-planning.

In no direction is there room for substantial advance in dealing with the problems of sanitation comparable with this. All large towns of which I have had experience are hemmed in by insanitary quarters which have been allowed to grow up with no attempt at control, and which are very often the starting grounds for plague. Cawnpore is an instance of what ought not to be done. There the land which should have been earmarked for the extension of the town has been cut up by endless brickfields, with the result that a huge population is crammed into an altogether inadequate space. Control of town development is essential alike in the interests of Government or the local authority, of the ordinary residents and of landowners. In the interests of Government or the local authority so that it may not be necessary in future to pay enormous sums for the main lines of communications and open spaces. And in the interests of landowners because the present want of system leads to an enormous divergence of values between land sites where the land may fetch almost any price, and land in the immediate neighbourhood which has only an agricultural value; whereas a well-considered scheme of town-planning would distribute values, prevent the piling up of monopoly values in the centre and spread the population and rise of rents over a larger circle.

I would submit that what is required is a Town-planning Act applicable to any area in which it may be desirable to control and regulate the expansion of a growing town. A Town-planning Bill is already under consideration in Bombay and legislation on similar lines was advocated for the United Provinces by the Sanitary Conference which included among its members many representative Indian gentlemen. A great deal of experience has been gained lately in western countries which should guide the lines on which advance can be made, and particularly in Germany and Sweden and lately in England.

The general principle of a town-planning scheme is that a scheme is prepared for a given area, distributing the land with which it is concerned to such and such uses, that this scheme is notified and discussed and settled, and that after it is settled owners are bound to conform to it.

The following suggestions follow in the main the lines on which it is proposed to legislate in Bombay, and the proposals of the Sanitary Conference.

A local authority would be constituted for an area in which any land is, or is likely to be used for building purposes. This body might either be the Municipal Council (as is proposed in Bombay) or the council *plus* representatives of Government, the landowners and other persons interested. There are strong reasons for constituting a special body to deal with these schemes. A municipal body should be adequately represented, but this could be insured by the local Government. The commission themselves recommend in certain cases the co-operation of outside interests on sub-committees. Otherwise the co-operation of landowners and of all interested should be ensured by frequent conferences at every stage of the scheme. This is the plan adopted in England (under regulations prescribed by the Local Government Board) and proposed in Bombay.

The local authority would be subject to the controlling authority, which would presumably, at any rate until experience had been gained, be the local Government.

The local authority would frame a scheme for the area, either *ipso motu* or at the requisition of the inhabitants or of the local authority. The fullest publicity should be given to the scheme at every stage; and in particular notice served on every owner. This again is secured in England by regulations framed by the Board. (In England landowners have power themselves to frame and propose a scheme, and if the local authority fail without due cause to adopt it, they may be compelled to do so after public enquiry by the Board.)

The scheme when completed would be submitted to the controlling authority which might approve, modify or reject it.

Full provision for hearing parties interested should be made at each stage. (In England before the scheme is finally approved by the Local Government Board notice of intention to do so must be published; and on due objection by any person interested the scheme must be laid before both Houses of Parliament for 30 days, and may be rejected by an address of either House.)

After approval the scheme would be notified, and all subsequent buildings or works in contravention thereof absolutely prohibited.

Each scheme would provide for the construction of roads and communications, the construction and alteration of bridges, &c., the plotting out of land as building sites whether intended for building in the immediate future or not; the reservation of land for open spaces, gardens, recreation grounds, schools, markets and public buildings of all sorts; drainage, lighting and water-supply; the rates of assessment and the incidence of the development tax on building sites and other lands; redistribution of sites, and compensation payable to persons whose property is injuriously affected by the scheme and any contribution payable by owners on account of increase in value of their property caused by expenditure of public money in the operation of the scheme.

† In the first instance the work of development would be financed by loans secured by the proceeds of a development tax; this tax would be assessed on all lands included in the scheme, and be leviable at the expiration of a prescribed period after the notification of the scheme. The levy of the

* Power to require a local body to frame or adopt a scheme is given in England to the Local Government Board (*vide* Appendix A).

† The suggestions as to a development tax and the power to be taken to redistribute properties, are taken from a note by Mr. Mead who was deputed on special duty by the Bombay Government in connection with this subject.

tax on any land included in the scheme might be deferred by the local authority, with the consent of the controlling authority. This would provide for the case of occupants wishing to preserve their agricultural holdings, as such, intact, and to avoid payment of increased charges, provided the exclusion of such land does not vitiate the general planning of an area which the majority of owners desire. The rates and incidence of the tax would be fixed by the local authority with reference to the total cost of

These are the Bombay proposals. the scheme and probable enhancement of value of properties included in each scheme. The local authority would be given power to borrow under the Local Authorities Loan Act, 1879.

After notification of the scheme power would be taken to absolutely prohibit building on any land within the area except in accordance with an approved plan and under such conditions as regards building as may be imposed by the local authority. If any person erects or proceeds with any building within a notified area after notification of the scheme, the local authority may demolish without compensation, recovering the cost from the person in fault.

Power would be given subject to the consent of the controlling authority to pool and redistribute after deducting lands for roads and open spaces all land of different owners who wish to develop and sell or build on their agricultural lands, but cannot sell the land as at present distributed in plots suitable for building on the approved plan. Such redistribution would be made if the owners of more than half the plots agreed. This is on the lines of the German *Lex adikes*, the object being to avoid compensation in cash by exchange of lands and to facilitate agreement between numerous small owners. The general principle followed is to plan large areas in close consultation with the parties concerned, and to take free up to a fixed limit the land required for future municipal purposes. The remaining land is redistributed in suitable building blocks to the original owners. The land which the owners receive, though smaller in area, has a greatly enhanced value, and the rates of the future municipality are saved a very heavy burden. If the loss by transfer of land to the municipality exceeded the profit from the enhanced value of the remaining property, compensation would be made by reduction or remission of the development tax leviable.

Planning building plots on land with diversified ownership (as particularly is the case in India) connotes some scheme for inducing agreements between owners. In England the power of the responsible authority to make agreements with owners and of owners to make agreements with one another is to be regulated under the fourth schedule of the Act by general provisions prescribed by the Local Government Board. In Germany where town-planning has been an accomplished fact since 1875 it has been found necessary to take power to pool and redistribute such land, and nothing short of this would probably be effective in India. The provision that redistribution should only be possible if a majority of landowners so decide is incorporated in the proposed Bombay Act. Planning must be done with care so as to avoid unnecessary redistribution, but if the majority refuse, planning must be postponed, and with it all sales for building purposes and building until they change their minds. This may temporarily retard development, but obstacles should be overcome by the due publication of provisional schemes.

Compulsory powers of acquisition would be given for land required for main communications, open spaces or other objects or works of a public nature, and also for acquiring a reasonable amount of frontage on the lines of main communication. Power should also be given to acquire compulsorily the land of recalcitrant owners refusing to build on, or to let or sell for building purposes land urgently required for the development scheme.

In England in the Bill as originally brought in it was proposed that if compensation were payable to any person on account of injury caused to his property by the operation of the scheme, the whole of this might be recovered if at the same time other property of the same owner had been increased in value (up to the amount of such increase). This was subsequently modified and extended, and under the Bill as passed the local authority is entitled within a limit of time to recover one-half of the increase in value in any property caused by the operation of the scheme. The arguments against this somewhat stringent enactment will be found in Appendix A in which I have given the main proposals of the English Bill. This particular clause goes beyond the conclusion reached by the committee on Town Sites—that the local authority is entitled to a share in that portion of the increase in values which has clearly been caused by the expenditure of public money. Obviously the rise in value might be brought about mainly by private expenditure on sewers, roads and buildings, and the local authority by the mere automatic introduction of a scheme would benefit to the extent of one-half. (The whole was originally proposed, but a compromise was reached on the lines indicated.)

The acquisition of frontages on the main roads would, on the other hand, afford a simple and automatic means of enabling the local authority to share in the rise of values caused clearly by the expenditure of public funds, and it would materially decrease the cost of a scheme and the consequent burden on the rates.

With regard to the proposed development tax, municipal bodies are already empowered to levy a tax on houses and lands. It is but just that the owner should be taxed for the development of areas, consequent on which his property will be largely increased in value. The rise in rates of agricultural rents within and immediately adjoining municipal areas has rendered the ownership of such land so profitable that it is becoming increasingly difficult and expensive to obtain sites for building purposes, and anything which tends to restrict the supply of building sites round great cities is in itself a serious evil. The great mass of the middle classes in Indian cities are everywhere showing a desire for improved dwelling houses and sanitary conditions, but under existing circumstances it is almost impossible for them to obtain the facilities they require.

(Signed) L. C. PORTER, I.C.S.,
Secretary to the Government of India,
Department of Education.

The 11th May, 1911.

The English Act.

The town-planning part of the Housing and Town-planning Act is contained in sections 54—67 with schedules 3, 4 and 5.

The following is an outline of the main provisions :—

The *local authorities* who will administer the Act are for London the County Council, and for the provinces the various Town Councils, Urban Councils and Rural District Councils. [Section 65 (1).]*

The Board may constitute a joint body to deal with land in the area of more than one local body. [Section 55 (3).]

Local authorities can do little or nothing at any stage without the consent of the Local Government Board, and running through the whole of the town-planning clauses is the question as to how that Board will give effect to the various regulations, general provisions, special provisions and interpretations of the particular clauses.

Thus before a scheme can be prepared at all the local authority must satisfy the Local Government Board that there is a *prima facie* case for making such a scheme. [Section 54 (2).]

A scheme may be revoked by the Local Government Board on the application of the responsible authority or of any other person appearing to them to be interested, if they think fit [54 (6).]

A town-planning scheme shall not have effect until approved by order of the Local Government Board [section 54 (4)] which may impose any modifications and conditions.

The Local Government Board will prescribe a set of general provisions for carrying out the general objects of town-planning schemes and in particular dealing with the matters set out in *Schedule IV*.—and these shall, as a rule, take effect as part of any scheme unless provision is made for their variation. [Section 55 (1).]

The Local Government Board will make general regulations regarding the procedure to be adopted in obtaining authority to prepare a scheme, the preparation of a scheme, notices required to be given in connection therewith, &c.

In particular, provision shall be made by those regulations to ensure the co-operation of landowners and others interested in the land at every stage of the proceedings, by means of conferences or other means provided by the regulations. [56 (1) and (2).]

If the local authority fails to prepare a town-planning scheme or to adopt one proposed by the local landowners, the Local Government Board may order it to do so. [Section 61 (1) (2).] A local public enquiry is necessary before this order can be made, and it can be enforced by *mandamus*. Modifications in the scheme ordered by the Local Government Board, and the effective execution of the scheme when approved, can be similarly enforced.

Finally the local authority is still further bound by the provision [section 54 (4)] that if any single owner or other person or authority interested objects in the prescribed manner to a town-plan after it has gone through all its stages, including approval by the Local Government Board, the scheme must be laid before both Houses of Parliament, and may be rejected by a resolution of the House of Lords or House of Commons.

What land may be the subject of a town-plan.—Section 54 (1) provides that a town-planning scheme may be made for :—

- (1) Any land in course of development.
- (2) Any land which appears likely to be used for building purposes.
- (3) Any land likely to be used for open spaces, roads, streets, parks or recreation grounds.
- (4) Any land likely to be used for any work incidental to a town-planning scheme, whether in the nature of a building work or not.

The scheme may be prepared by the local authority for land within or in the neighbourhood of their area.

In Germany the expression “likely to be used for building purposes” covers land likely to be used during the next 30 years.

Any question as to whether land comes within the foregoing categories will be decided by the Local Government Board whose decision will be final.

The effect of section 54 (3) is also to enable a town-planning scheme to include pieces of land already built upon, or which are not likely to be used for building purposes, when in the opinion of the Board they ought to be so included.

Objects of town-plan.—These are defined by section 54 (1) as securing proper sanitary conditions, amenity and convenience in connection with the laying out and use of the land and of any neighbouring lands.

General provisions.—The extent to which these objects may be dealt with will be defined in a set of general provisions to be prescribed by the Local Government Board [section 55 (1)] in accordance with the fourth schedule, which mentions streets, buildings, open spaces, the preservation of objects of historical interest or natural beauty, sewerage, drainage, lighting, water-supply, rights of way, obstructive buildings and any consequential works to the foregoing as being within the scope of a town plan. These general provisions are to be laid before Parliament.

Special provision.—Section 55 (2) provides for the insertion in every plan of special provisions, defining the area, the authority to be responsible for the execution of the scheme, supplementing, excluding or varying the general provisions, and providing for special circumstances, and suspending so far as may be necessary any statutory enactments, bye-laws or other provisions in operation in the area.

Procedure before and during the preparation of a scheme.—Section 56 and Schedule.

This is to be laid down by regulations issued by the local Government Board. In particular, before applying for authority to prepare a scheme, the local authority must prepare plans and estimates, and issue such notices as may be required by the regulations.

*Schemes may be prepared either by the local authorities, or proposed by all or any of the landowners [64 (2)].

Before the proposed scheme is submitted to the local Government, similar notices are to be given, and the objections of persons affected (including archæological and other societies) heard; notice of intention to approve the scheme must also be published, and objections may be lodged thereto (section 54 (4) see above).

The local authority must also publish or deposit for inspection any scheme or proposed scheme and give information to persons affected. (Schedule V).

Power to enforce schemes.—Section 57.

After giving such notice as may be provided by a town-planning scheme the responsible authority may pull down or alter any building in the area in contravention of the scheme, and execute any work which it is the duty of any person to execute under the scheme, in any case in which it may appear that delay in the execution of the work will prejudice the scheme; recovering expenses in each case from the persons in default.

Any question as to whether such building is in contravention of the scheme will be determined finally by the Local Government Board.

Compensation.—Section 58.

No compensation can be claimed by any person for a building erected on or contract made with respect to land in the area, after the time that application for authority was made; except as respects work done before final approval of a scheme to complete a building or to carry out a contract entered into before application was made.

Otherwise any person whose property is injuriously affected by a scheme, may obtain compensation if he makes his claim within the time limited by the scheme (not being less than three months after the date of notice of approval published by the Local Government Board).

Any question as to whether property is injuriously affected, and as to the extent of compensation payable, will be determined by the arbitration of a single arbitrator appointed by the Local Government Board (unless the parties agree on some other method).

Parliamentary warfare waged furiously round this provision (see below).

Betterment.—Section 58 (3).

Where *any* property is increased in value by the making of a town-planning scheme, the local authority is entitled (within the same time limit as prescribed in the case of persons claiming compensation) to recover from the person whose property is so increased in value one-half of the amount of that increase.

Parliamentary warfare waged furiously round this provision (see below).

Disputes to be decided in the manner prescribed in the case of compensation.

Exclusion and limitation of compensation in certain cases.—No compensation can be claimed on account of provisions in the town-planning scheme if such provisions would have been enforceable by bye-laws made by the local authority.

In particular no compensation can be claimed on account of provisions prescribing space about buildings or the height or character of buildings, or limiting the number of buildings to be erected, and which the Local Government Board considers necessary (section 59).

Acquisition of land.—The local authority may for the purpose of a town-planning scheme purchase *any* land comprised in such scheme by agreement, or may be authorised to purchase land compulsorily, by means of an order submitted to the Local Government Board and confirmed by that Board in accordance with Schedule I. of the Act. The schedule, *inter alia*, lays down that in determining the amount of any disputed compensation, no additional allowance shall be made on account of the purchase being compulsory (?). Any question of disputed compensation shall be determined by a single arbitrator, appointed by the Board, which will fix his remuneration. In urban areas, if an order is objected to, an impartial person not in the employment of a Government Department will hold an inquiry. The enquiry is limited to the question whether the particular land is suitable for the purpose for which it is to be acquired and whether its compulsory acquisition is unduly detrimental to the persons interested. The Board may confirm the order for compulsory acquisition notwithstanding the report of this person, but in such cases the order is provisional only and will not have effect unless confirmed by Parliament.

The opposition to the Bill centred round three main points:—

- (a) The extensive powers given to the local Government Board to supervise, overrule and, if necessary, compel the local authorities to act.
- (b) The tribunal set up by the Bill to determine finally questions as to what land was or was not to be construed as building land, of compensation and contributions of owners on account of betterment and of compulsory acquisition of land. In all these cases the deciding authority is the Local Government Board or an arbitrator appointed by the Board.
- (c) The vexed question of the share of betterment to be taken by the local authority.

On the first two questions the Government refused any concession, and in particular (on the score of expense and delay) the substitution of the courts or arbitrators appointed by the courts, for the tribunal set up by the Bill.

As regards betterment, the clause originally drafted limited the recovery of betterment to the amount of compensation payable, and no amount was recoverable unless compensation was due under the scheme.

The standing committee extended the scope of the clause and as introduced it provided that when any property "is, or will be, increased in value by the operation of a town-planning scheme," the local authority would be entitled to recover the whole amount of the increase from any person whose property was so increased in value.

The vagueness of this clause as to future increment of value was partially remedied by the excision of the words "or will be."

It was pointed out that the increase in value might well be caused by private expenditure on the part of the owner ; and that recovery should be limited to the amount by which the property had clearly been increased in value by the expenditure of public money. This proposal and a proposal to limit betterment recoverable to the extent to which compensation was payable to the *same* owner, were not accepted by the Government.

In the Lords a compromise was proposed by which one-half the increased value went to the owner and one-half to the local authority, and that compromise was eventually embodied in the Bill as passed.

APPENDIX 7 to No. 4.

USES AND LIMITATIONS OF SMALL MODELS OF SEPTIC TANKS.

The experience that has been gained from the use of septic tanks in India is now becoming very considerable, and there is no doubt that when properly designed these appliances are a very decided success ; in fact, it may be said that they have absolutely solved the problem of the best method of disposal of excreta in large communities, such as the labour in mills, in railway workshops, and in institutions, such as lunatic asylums, jails. The problem that we are now asked to solve is as follows :—Can we do anything to make septic tank latrines form a suitable substitute for the stinking hand removal latrines that are so common in most municipalities in India? There is no necessity for me to say anything whatever on the subject of imperfections of the usual hand removal latrines. All sanitarians are perfectly well aware of these.

Experience has shown that septic tank latrines work best when they are designed for daily number of users varying from 1,000 to 4,000. Obviously, therefore, a large latrine to accommodate 2,000 users per diem is not a suitable type for a small town, because it would be underused and too expensive. If latrines are to be used they must be placed reasonably near habitations, and in many of the Indian towns the population is not sufficiently dense to allow of building latrines for, say, 1,000 users per day. In mill bustees this type has been constructed and they answer extremely well. They do not work as well as the latrine in the mill themselves, because the load is not as constant, but at the same time they are a decided success provided they are designed correctly. There can, however, be no doubt that a simple latrine for 100, 200 and 500 users per day would meet with much success in suitable localities. I herewith submit designs for latrines for 100 and 200 users per diem. They are designed to be extremely cheap and make use of no complicated mechanisms. The amount of water required is not very great, varying from 500 to 1,000 gallons per day. The dilution is 5 gallons per user per diem. The capacity of the tank gives a three days' rest ; the cost of building the latrine is about a thousand rupees in the case of 100, and 1,400 rupees in the case of 200 users.

At present it is impossible to say whether a small latrine of this kind is going to be an entire success if it is situated in a thoroughfare to be made use of by the public. A model of this type is being constructed and is being experimented upon. The difficulty is, that in a latrine designed for 1,000 users per diem the chances of ever getting an overload of more than 5 or 6 per cent. are not great, but a latrine that is designed for 100 users per diem might very easily, under certain circumstances, be visited by 150 or even 200 people. Is it possible, therefore, to design a latrine which will give a reasonably good result under these circumstances? At present I regret to say that our practical experience on this point has not yet gone very far, but from the work that has been carried out I think it is safe to say that as long as the first partition or grit chamber of the latrine is made of large dimension, a variable load can undoubtedly be accommodated without much falling off in the quality of the effluent. The majority of night-soil passes in in more or less solid masses, and these remain in the grit chamber until they are broken up. As long as masses do not pass into the body of the tank, the effluent, though it may be very concentrated, is fairly free from odour and suspended matter and is generally satisfactory. But if fresh faeces get beyond the grit chamber, the amount of easily oxidisable matter goes up very rapidly. Consequently, in building latrines for public use, especially if they are small, the grit chamber must be able to accommodate a large quantity of solid material without allowing it to pass into the body of the tank. This is by far the most important point in the design and must be carefully borne in mind.

Of course, the remarks that apply to septic tanks in general must always be investigated even before a small installation is kept up. There must be an adequate supply of water, and there must be a suitable way of disposing of the effluent. Water should, as a rule, be supplied from a pipe service and not be drawn out of wells for the purpose. Effluent may be passed down ordinary pukka drains, especially if it is sterilised, but cannot be allowed to flow into the usual kutchra drains. Personally, I am hopeful that a latrine somewhat of the type shown to accommodate about 200 users per diem will be a great benefit to sanitation of towns and will do away eventually with the stinking night-soil carts and the expense of carrying away large quantities of night-soil and urine, a process which is fraught with large amount of nuisance and with large expenditure of public funds.

(Signed) W. W. CLEMESHA, M.D., D.P.H., Major, I.M.S.

APPENDIX 8 to No. 4.

WATER-SUPPLY AND DRAINAGE WORKS IN THE MADRAS PRESIDENCY.

The number of inhabitants in the Madras Presidency, according to the latest census taken in 1911, is given as 41,401,839.

This number may for all practical purposes be divided into three principal parts or divisions :—

- The North-east, or Telugu part, population, 16,000,000 ;
- The South, or Tamil part, population, 21,000,000 ; and
- The West, or Malayalam and Canarese part, population, 4,000,000.

Of these three divisions the most progressive in the way of sanitary reform and in the provision of water-supply and drainage works is the South, or Tamil, followed by the Telugu-speaking part in the North-east. The West, or Malayalam and Canarese part, is at present backward in the advancement of sanitary measures, the apparent reason being the heavy annual rainfall which ensures generally sufficient water-supply from wells, while at the same time the roadside drains, backyards, and streets are periodically flushed and cleansed.

The area of the Presidency is given as 141,705 square miles, of which 78,000 square miles may be allotted to the North-east, or Telugu part, 53,000 square miles to the South, or Tamil part, and 10,000 square miles to the West, or Malayalam and Canarese part.

The number of municipalities in the Presidency is 61, excluding the Corporation of Madras, and in addition there is a large number of unions or large villages subordinated to the Taluk and District Boards. These unions, with the help of the District Boards, are now coming forward with requests for water-supply and drainage works, thus following the example of the municipalities.

2. Proposals for drawing up water-supply and drainage schemes are usually first suggested by the Sanitary Commissioner during his inspection of towns, and occasionally by the Sanitary Engineer or the local bodies themselves. Owing to the progress made in educating the local bodies to the necessity for water-supply and drainage works and to encouragement given to such proposals by the last two Governors of Madras, Lord Amthill and Sir Arthur Lawley, and also to the generous financial assistance offered by the Madras Government, the number of such proposals has steadily increased until the Sanitary Engineer has now 53 schemes on his programme to be investigated and drawn up in detail as soon as possible.

3. The increase in the number of water-supply and drainage proposals has rendered necessary an increase in the Sanitary Engineer's staff, which now consists of myself, four Assistant Sanitary Engineers, one personal assistant, twelve surveyors and twenty-seven members of the drawing office.

4. The investigation and drawing up of schemes for water-supply and drainage works is solely undertaken in the Madras Presidency by the Sanitary Engineer, with the exception of those for the City of Madras, which Corporation maintains its own engineering staff.

5. The introduction of water-supply and drainage works in the Presidency outside the City of Madras may be said to have started with the appointment of a Sanitary Engineer to Government in January, 1890.

6. The first progress made was in the introduction of the earlier water-supply works. Drainage works were not carried out at first, the Sanitary Engineer's time and funds available being concentrated on the provision of water-supplies.

7. It was found that Municipal Councils were unable to arrange for the introduction of both water-supply and drainage works, and consequently the latter works were deferred and the old earthen side drains and badly laid masonry ones were called on to serve the impossible duty of dealing with the spill water from public fountains and the increased sullage discharge from house drains due to the augmented supply brought by the water mains and house connections.

8. The result was stagnation of sullage water in these drains and encouragement to the propagation of mosquitoes. Various attempts were made to deal with the spill water from fountains, and lately the provision of filter trenches of special design, and what is called filter wells, have been stated by one Council to have satisfactorily disposed of the nuisance.

Plans of these filter trenches and filter wells will be shown at this Conference.

9. Despite the disadvantage due to difficulties in disposal of, or want of disposal of, increased quantities of sullage, there is no intention to defer the introduction of piped water-supplies in mofussil towns where the introduction of a drainage work simultaneously is still financially impossible.

10. It is considered that the resulting improvement in health to the inhabitants of a town by the introduction of a protected and piped water-supply far outweighs the disadvantages resulting therefrom by the absence of efficient drainage arrangements. Thanks mainly to the high average temperature and the absence of rain for the greater part of a year, the soil at the roadside drains is more porous than it would otherwise be and the makeshift arrangements for disposal of spill water at fountains and the provision of cesspools, more or less impervious, for house sullage, minimise the evil results from the absence of good drains.

11. In the Sanitary Commissioner's Administration Report for 1910 the health statistics, amongst others, of 12 towns possessing protected water supplies were given, and Government in reviewing this report remarked as follows :—

“The bearing which water supply has on the prevalence of cholera is illustrated by the statistics embodied in statement XIII appended to the Sanitary Commissioner's report, from which it appears that, in the twelve towns where an improved system of water-supply has been in force for more than five years, the average mortality from this cause was 5·8 per cent. of the total mortality during the quinquennium ending with 1910 as against 9·8 per cent. for the five years immediately preceding the date of the introduction. It may be added that under fevers there was a simultaneous and not less marked improvement from 25 to 16·5 per cent.”

As none of these towns possess modern drainage works the gain to the health of a town by the provision of a protected water-supply scheme, even when unaccompanied by a drainage scheme, is considerable, and this fact should be remembered by those who think that, because a town cannot afford to construct simultaneously both water supply and drainage works, the former should not be introduced in advance of the latter.

12. It may be taken as the accepted policy in the Madras Presidency that the provision of a piped water-supply in mofussil towns is approved prior to the introduction of a drainage scheme. While the necessity for the provision of a drainage scheme is recognised this drainage scheme is deferred owing solely to the want of funds.

13. It seems to me that with funds limited the provision of a piped water-supply is of first importance. Local supplies from wells, tanks and rivers in the vicinity of towns are without

exception contaminated, and the consumption of water from contaminated areas affects more directly and quickly the health of the people than the stagnation of sullage, however bad it may be.

Under the Madras District Municipalities Act, the maximum tax that can be enforced for water-supply and drainage purposes is 8 per cent.

14. The income of an ordinary mofussil municipality of 30,000 inhabitants in the Madras Presidency from this 8 per cent. tax can be taken as Rs.14,000 to Rs.15,000, which represents an available provision of capital, if borrowed at 4 per cent. repayable in 30 years, of $2\frac{1}{3}$ lakhs of rupees.

Assuming for simplicity that the working expenses of a suitable water-supply scheme are paid from the general revenues of the municipality, this sum of $2\frac{1}{3}$ lakhs is all that is available from municipal funds for the provision of water supply and drainage works.

15. As the cost of a water-supply scheme, involving pumping by suitable pumping plant, may be taken as from 3 to 4 lakhs of rupees for an average municipality of 30,000 inhabitants, it will be noted that without assistance from outside sources such a municipality is unable to carry out either water supply or drainage schemes and certainly not both.

16. Owing to the generous encouragement and financial assistance of Government and in certain cases of private individuals, notably the Maharanee Appalakonda Yamba of Vizianagram, the Mahant of Tirupati and the Honourable Mr. S. R. M. Ramasawmi Chettair of Chidambaram, a fair number of towns in the Madras Presidency now possess piped water-supplies.

Certain of these towns owing to rising revenue, an increasing interest in sanitary matters, and the desire to construct drains and thus remove the nuisance caused by the additional discharge of sullage into earthen side drains or cesspools, have now resolved to construct drainage works on modern lines.

17. The number of water-supply schemes carried out in mofussal towns in the last 21 years in the Madras Presidency, practically since the appointment of a Sanitary Engineer was sanctioned, is 19, and in addition 6 more are under construction, making a total of 25 excluding the City of Madras. A list of these schemes is given in an appendix.

18. In addition to the 25 water-supply schemes constructed throughout the Presidency there is the important water-supply of the City of Madras which has a present population of 517,335 according to the 1911 census. Nearly 40 years ago when the population was nearly 400,000 distribution pipes were laid down throughout the city and a supply of water was brought from a large irrigation tank situated at the Red Hills, 9 miles beyond the city boundaries, by an open channel to a masonry well located on the western boundary of the city. From this well which serves as a stand pipe the distribution pipes begin. These works cost originally 14 lakhs of rupees.

In order to preserve the static level of the water as much as possible so as to make a gravitation scheme possible the outlet from the tank was constructed at such a high level that it was found necessary in years of deficient rainfall to supply the high level outlet to the channel with water pumped from the lower levels of the tank. For the same reason the channel as it approached the city was carried on an high embankment, which, it may be noticed, has stood wonderfully well.

Owing to the increased demand for water and the trouble experienced from the deposition of silt carried forward from the open channel into the cast-iron distribution pipes, plans and estimates for improvements were drawn up by Mr. H. Nowroji, Assistant Sanitary Engineer to Government in 1905, and subsequently sanctioned by the Corporation and Government.

This scheme provides for the tapping of the Red Hills tank at a lower level than the present channel outlet, the provision of a roughing filter near the outlet and the construction of a masonry conduit, 9 miles long, in lieu of the existing open channel. On the arrival of the water at the western boundary of the city it will be filtered through slow sand filters and partly stored in underground reservoirs and then pumped by steam pumps to an elevated tank whence it will be distributed to the city.

The cost of these improvements was estimated at Rs.24 lakhs and a considerable portion of the works has already been executed. It is also in contemplation to improve the distribution pipe arrangements in the city at a cost of many lakhs of rupees so as to meet the demand from the increased population. The supply per head is also to be increased from the original provision of 16 gallons to 25 gallons.

19. The 25 water-supply schemes constructed or under construction in the Madras Presidency may be divided into the following types :—

Gallery scheme	...	...	...	...	...	...	...	...	...	12
Well scheme	...	...	...	...	...	...	...	...	...	1
Storage tanks with filters	...	...	...	...	...	...	...	...	...	9
Storage tanks without filtration	...	...	...	...	...	...	...	...	...	3

This list shows that the water-supply schemes are practically of two classes, the gallery type and the storage tank type with or without subsequent filtration. A gallery scheme of water-supply is much in favour in Madras for two reasons. The first is the low cost of construction and maintenance and the second reason is the simplicity of working.

Both of these reasons are of first importance in Madras owing to the fact that the water works are in charge of Municipal Councils who are unwilling to spend comparatively large amounts in construction, maintenance, and superior supervision.

20. An infiltration gallery as finally developed in Madras consists of a trench or gallery in a river-bed and is usually from 20 to 30 feet deep. This gallery is excavated either across the bed or longitudinally in the direction of flow of the river according to the results obtained from preliminary investigation. This investigation consists first in the selection of a suitable site above the town and outlying villages to be as free as possible from contamination, and secondly by the putting down of 40 to 60 borings to a sufficient depth, say from 30 to 50 feet. These borings are put down in a longitudinal section up and down stream and at increasing distances apart, and on these results the further borings to determine the cross sectional conditions of the river-bed are put down. In the

majority of cases these borings either show a depth of fine and coarse sand ranging from 20 to 30 feet thick or alternate layers of sand and clay.

In the former case the gallery depth would be determined by the available depth of water in the summer season with reference to the usual condition that there is no surface flow in the river during this season.

In the latter case of alternate layers of sand and clay the gallery would be located so as to draw its principal supply from the deepest sandy layer, if, of sufficient coarseness, and to rest on the underlying layer of clay.

21. Samples of sand from the borings and from different depths would be taken and mechanically analysed to determine the coarseness of the sand and especially to observe the percentage of fine sand and silt contained in the coarse layers. The continuity and extent of the sand layers would also be calculated to determine the water contents.

If the samples of sand were found to be satisfactory, that is to say, with an uniformity co-efficient not less than 3 as shown in the accompanying appendix, then it would be considered that the sand in the river-bed was suitable for the location of a gallery therein.

As many rivers in Madras have occupied in former times other positions, it is advisable to trace out by borings the old course of the river-bed which is now dry land and to locate on this land the gallery itself instead of in the present bed. While the latest form of gallery adopted is a trench, there are several cases in which the gallery takes the form of an underground filter bed protected by a barrage wall built across the river-bed and with the top of the wall submerged. The most successful galleries are those which have been located in a sandy river-bed.

22. In the case of one of our works not in a river-bed where the gallery or trench was excavated in decomposed syenitic rock overlying hard syenite it has been found that, as is usually found in the case of wells in such rock, where the draw off is considerable, the construction of the gallery or trench has permanently lowered the ordinary sub-soil water level. In this case the only solution for augmenting the supply is to extend the gallery, but this type is not one on which reliance can be confidently placed.

23. In the case of galleries in sandy river-beds, those rivers receive from time to time floods which recoup the supply of water in the sandy bed.

Diminution of supply in these galleries can be confidently met by the extension of the gallery preferably across the river-bed or if necessary in a longitudinal direction up stream.

In this connection it may be noted that the extension of the gallery is only possible in those cases where the scour due to flood water does not reach more than 10 feet or so below the normal bed level. Where the scouring action of flood water would reach below this level a gallery placed across stream must be protected by a masonry wall on the down stream side.

24. In those cases where the gallery is a longitudinal one and the river water in flood time exerts deep scouring action the site of the gallery would usually be on the bank of the river outside the scouring action of flood water.

25. The trench type of gallery is constructed as follows :—

An open excavation is made in the river-bed in the summer season down to water level, and below this level the trench is excavated with the aid of timbering and sufficient pumping power to the depth desired which as already stated is usually 20 to 30 feet below river-bed level.

The width of the trench will usually be 8 feet and at the bottom a layer of broken stone, 1½ inch size, is laid to a depth of 1 foot. On this layer one or two lines of open jointed stoneware pipes are laid with a slight fall towards a collecting well on the river bank. The trench is then filled in to a depth of 6 feet with broken stone, beginning with 1½ inch size and completing with ¾ inch size. The planking and shoring are removed as the filling proceeds and the construction pumps keep the water down to below the top of the filling.

Above the ¾ inch size of broken stone, coarse sand is laid to a depth of 3 feet and above this layer the ordinary river-bed sand.

The gallery is constructed in lengths of 100 or 200 feet according to the quantity of water to be pumped out, and this water is measured as the work proceeds so that data may be obtained of the available supply.

26. As a rule in those rivers of limited cross section and without perennial flow the gallery is the first work to be constructed and until a test has been made of the quantity of water available the remainder of the works including the supply of pipes is deferred. A question that is often asked is whether these galleries do not become rapidly choked.

This, it is thought, is almost entirely a question of the percentage of fine sand in the deep coarse sand layers of the river-bed at the site of a gallery. Provided the percentage of fine sand is small there is no reason why such galleries should not work for 20 years or even longer.

In the case of the gallery at Conjeeveram water-works no trouble has been experienced from any movement of fine sand into the broken stone layers and stoneware pipes of the gallery and this after 15 years' working. In addition to no diminution in quantity the quality of the water has maintained a high standard of bacteriological purity.

27. It is however recognised that in cases of supplies from sandy river-beds where the sand contains a comparatively large percentage of fine sand which will pass through a sieve of say 100 meshes to the lineal inch and where the reduction in water level or infiltration head exceeds, say, 4 feet, there is every likelihood of this fine sand being carried forward into the interior of a gallery.

In such cases it is considered that a gallery is unsuitable and the headworks should take the form of wells which can be easily disconnected and periodically cleaned of the fine sand which may have entered the wells.

28. In the case of the filter-bed type of gallery with a protecting barrage wall which has had to be cleaned every five or six years, it is considered that the frequency of cleaning required is owing to the excessive head caused by the increased demand for water and the want of sufficient area of filter bed and also to the periodical floods depositing mud on the surface of the river-bed, this mud being carried into the interior of the filter bed by the powerful suction action of the pumping engines during the day's working.

29. *Storage tanks.*—It has already been stated that the number of water-supply schemes in Madras, of which a storage tank is a component part, is 12. These are usually provided where it is

impossible to draw up a gallery scheme at a reasonable cost owing to the distance from the town of a suitable river with a sandy bed.

30. These tanks are constructed preferably of a capacity equal to three years' supply in localities where the rainfall is low or variable. The result of storage in open tanks or lakes has been found to be highly beneficial to the quality of the water.

The capacity of a tank requires to be enormously increased by provision for evaporation and absorption. This is usually taken in the case of water-works tanks in Madras at $\frac{1}{2}$ inch per day over the area at $\frac{2}{3}$ of the depth of the tank, less the usual recoupment during the period.

Although it is recognised that all cultivation should cease within the catchment of a storage tank yet for financial reasons it is found impossible as a rule to insist on this and we have to be content with the acquisition of land within 1,000 feet of the line of water spread at maximum water level.

31. In the case of a tank which had laterite earth on the surface within the catchment area, heavy rain in the monsoon months resulted in the water of this tank becoming red in colour, and with a large proportion of mud in suspension. This laterite mud, owing to its fineness, was found to be incapable of deposition even after several months and the sand filters which were in use gave great trouble owing to their frequent clogging. The introduction of mechanical filters for roughing purposes was therefore seriously considered when owing to the acquisition of certain cultivated dry land within the catchment area the presence of laterite earth in suspension in the tank water suddenly ceased thus obviating the necessity for mechanical filtration.

It is therefore suggested that in similar cases the prevention of cultivation of dry land of certain kinds within the catchment of a tank is advisable.

32. From the analyses of the waters of storage tanks in Madras it is considered that, provided there is no abnormal amount of silt in suspension, the provision of 1,000 feet margin around the maximum water level by the acquisition of land 1,000 feet in breadth is a sufficient protection against the contamination of the tank water by the run off, from the rest of the catchment even when cultivation is carried on in the remainder of the catchment area to a considerable extent.

This statement is however subject to the condition of sufficient storage in the tank and to the draw off of water 3 feet below the highest level available either by a floating pipe or by a draw off stand pipe with valves at different levels.

33. Our tanks are being constructed with embankments or bunds 9 feet wide at the top and with front slopes $1\frac{1}{2}$ to 1 and rear slopes 2 to 1. In the future it will however be better to adopt slopes of 2 to 1 and 3 to 1 respectively, so as to minimise leakage from the tanks and to obtain a stronger embankment.

The front slope is usually pitched with stone 18 inches thick over gravel 12 inches thick.

34. *Filter beds.*—The only filter beds in use in Madras at present are of the ordinary sand filter type and these have given very variable results in the past owing to want of superior supervision by the local bodies.

The type in use is the ordinary European type consisting a masonry tank, rectangular in form, filled up with 2 feet of broken stone of size $1\frac{1}{2}$ inches to $\frac{3}{4}$ inch and sand of varying coarseness, the first layer above the $\frac{3}{4}$ -inch stone being sand, retained on a sieve of 10 meshes to the lineal inch, to a depth of 4 inches, the sand above this layer being that which will pass through a sieve of 20 meshes and be rejected on one of 30 meshes. This layer is 2 feet 8 inches thick. Above the top sand layer the minimum depth of water is 3 feet.

35. Rules drawn up by me for the working of sand filters in Madras and for the scouring of pipe distribution lines are given as appendices to this paper.

Our experience of sand filters in the Madras Presidency has been disappointing. Shortly after the filtering material in a filter bed has been relaid the filtrate has given excellent results, but as a rule the bacteriological analyses of samples by the Maconkey system has shown variable results either from want of attention to the working, indifferent sampling, tropical conditions in Madras, or the system of analysis itself.

36. Accordingly, I recommended to the Madras Government, and they have since sanctioned, the installation at a cost of Rs. 34,000 of experimental filters, both ordinary sand filters and mechanical filters, to be erected at the King Institute, Guindy, in order that some practical conclusion could be arrived at as to the actual working of filters under Madras conditions.

It has been suggested that the broken stone layers of a sand filter should be reduced from 2 feet to 1 foot in thickness in order to reduce multiplication of bacteria in the post filtration passages. This proposal appears to be contrary to the practice in Europe, but the experimental sand filters to be erected at the King Institute will show by actual results from samples taken at different depths what actually happens, out of sight, in a filter bed.

Another proposal to reduce the depth of water from 3 feet to 2 feet in order to reduce the total depth of a filter bed, we have already negatived by experience of working with such a depth in the Cocanada filters. Owing to the rapid growth of algae in the shallow water, it is found necessary to revert to the provision of a minimum depth of 3 feet.

37. In connection with the position of sand filter beds in relation to the storage tank, our experience in Madras has shown the necessity for their construction at some distance from the storage tank or in some position where the normal sub-soil water level will be below the level of the floor of the filter bed in order to avoid the coming in, by diffusion through cracks, of sub-soil water into the bed below the sand layer.

Inlet valves are automatically regulated and the outlets are provided with Glenfield Jones' automatic filter outlet apparatus so as to ensure the steady draw off from each bed of a quantity of water not greater than 450 gallons per square yard per day. These outlet automatic valves are also so set as to limit the maximum head of draw off to 2 feet.

As the supply to the towns is usually for only 16 hours in the day-time at the rate of 15 gallons per head, storage is provided in covered reservoirs of 8 hours' supply for the water filtered at night.

The provision of a continuous supply although highly desirable is not one which ordinary municipal Councils require and if given under present conditions would result in the wastage of almost the whole of the night's supply.

Until lately the powers of regulation were so limited by the provisions of the District Municipalities Act that it was found impossible to safeguard consumption of water especially at night.

Since then an Amendment Act has been passed which gives the Chairman of a Council necessary powers to fix meters and to enforce rules against wastage of water.

It is therefore hoped that there will be less wastage in the future than in the past which wastage was encouraged by the early introduction of certain water-supplies prior to adoption of rules and bye-laws for regulating consumption.

DRAINAGE WORKS IN MADRAS.

38. Mofussil towns in the Madras Presidency are so hampered by want of funds for carrying on both water-supply and drainage works simultaneously that it has been the invariable policy to utilise available funds for the introduction of protected water-supplies. Drainage works have had to be deferred until finances improved. Numerous petty improvements have, from time to time, been carried out to roadside drains in towns pending the drawing up of complete drainage schemes. In many cases the expected improvements in roadside drains have only been locally successful in transferring the stagnating sullage from one street to the next in such a manner, owing to faulty levels, that it is found impossible to join up the petty improvements to a proper outfall.

Of late years the construction by local bodies of old lengths of open drains has been discouraged, where observed, and the local bodies have been strongly advised to await the preparation of a general scheme of drainage with the object of laying down the correct levels of drains in all streets so that improvement to the drainage by construction of street drains can proceed from year to year as funds become available thus ensuring that all money spent on drains is usefully expended.

39. In the whole of the Madras Presidency there are only two modern sewerage or drainage systems—that existing in the City of Madras and that constructed at Ootacamund.

40. The drainage system in Madras consists in the division of the city into a number of sections each with a pumping station, to the pump well of which sullage gravitates through stoneware pipe sewers.

The sullage is pumped out of the pump wells by steam plant in some cases and by oil engines and centrifugal pumps in others and is forced through a cast-iron rising main of a total length of 9 miles to a sewage farm located on the sandy area north of the city and adjoining the seashore.

41. The most populous section of the town is drained by open drains and two intercepting sewers to a pumping station where the sullage is pumped through an independent rising main to the same sewage farm.

The pipe drainage of another section of the city is now under construction.

42. The soil of the sewage farm is almost pure sea sand, and the farm which extends to 150 acres has from the first been highly successful in disposing of the sullage pumped on to the farm.

The crop grown on the farm is hariali grass which is made into hay and sold as fodder for the feeding of horses.

The farm yields a revenue of Rs.30,000 per annum or Rs.200 per acre.

This large yield is due to the porous nature of the soil, the high average temperature of the atmosphere, and the fertilizing nature of the sullage. The quantity of sullage pumped on to the farm per acre appears to be 30,000 gallons, and this comparatively large quantity is satisfactorily disposed of as the sullage is comparatively weak and the sandy soil of the farm is capable of absorbing a large amount of liquid.

In the future the sullage will become stronger in composition and it may then be necessary to add septic tanks to the system.

43. The second drainage work carried out in Madras on modern lines is that at Ootacamund on the Nilgiri Hills. In this town a system of 6 and 9-inch stoneware branch sewers on the separate system was laid down connecting up all the important inhabited parts.

Owing to the steep location of the town it was necessary in many cases to introduce drop manholes on the lines of branch sewers and in other cases to use cast-iron pipes instead of the usual stoneware pipes.

44. The following were the limiting gradients adopted for the stoneware pipe sewers :—

							Full and half full velocity.
<i>6-inch sewers.</i>							
Minimum	...	...	...	...	...	1 in 100	2½ feet per second.
Maximum	...	...	...	...	...	1 in 40	4 "
<i>9-inch sewers.</i>							
Minimum	...	...	...	...	...	1 in 190	2½ feet per second.
Maximum	...	...	...	...	...	1 in 76	4 "

The beginning of each 6-inch branch sewer was provided with Field's flushing syphons of 90 gallons capacity and the system was ventilated with air inlets alternating with 4 inches ventilating shaft outlets 20 feet high at every manhole not more than 300 feet apart. The distance between ventilating shafts was therefore not more than 600 feet.

45. The branch sewers discharge into an old 12-inch cast-iron main sewer laid along the margin of the Ootacamund lake. Owing to this location the main sewer was not found to be as satisfactory as it should have been. The gradient averages 1 in 903 and it is now contemplated to lay down a new 18-inch cast-iron main sewer with a grade of 1 in 414.

The present 12-inch main sewer is flushed with stream water and also with sewage by means of three 5,000-gallon masonry flush tanks which are filled from high level branch sewers.

46. The public latrines have been rebuilt as water carriage flushing latrines and dumping pits are being provided as pail depôts.

A night-soil shoot has been built near the septic tank and is in daily use with satisfactory results to the conservancy of the town.

47. The sewage is disposed of by means of a septic tank of 24 hours' capacity, or 200,000 gallons, and a sewage farm of 14 acres.

The soil of this farm is more or less of a heavy nature and it has consequently been provided with sub-soil drains 33 feet apart discharging into an effluent channel which runs along one side of the farm.

The net revenue from the produce of the farm, principally grass and green oats, is nearly Rs.100 per acre per annum and the disposal works have satisfactorily met the problem of turning the raw sewage into an inoffensive effluent.

48. There are altogether in the town 1,423 house connections most of which have been provided for the Indian houses at the cost of the scheme. It was intended that the owners of European houses, in proximity to the sewers, should put in house connections as soon as the system was laid down. This they have not done up to date apparently in the hope that Government or the Municipal Council would construct the connections and debit the cost to the estimate for the drainage works.

The works were practically completed three or four years ago and ever since they were projected they have been subjected to a large amount of public criticism so that the Council hesitated to become responsible for them. This criticism reacted on the house owners themselves who found that the visitors, not understanding the real situation, preferred to go to other hill stations. The criticisms if not actually started were certainly fostered by newspapers which rarely lost a chance of deriding modern drainage works as carried out at Ootacamund.

If there was unusually heavy rain of, say, 2 inches in the hour, and the old main sewer surplussed this was held up as conclusive proof of the failure of the works.

As the system was only intended to carry away rainfall up to 1 inch per day, which means a dilution of sewage over six times the dry weather flow, the old main sewer necessarily surplussed.

Gradually, as minor mistakes in construction were rectified, the agitation subsided, with the result that the Municipal Council, after three years' experience of the working of the drainage system, have voluntarily proposed to take over, and have actually taken over, charge of the works. This change of opinion has been assisted by the discovery that, while other hill stations were suffering from unhealthiness, the public health of Ootacamund had apparently improved of late years.

49. In this connection I should like to take this opportunity of quoting from the reported speech of his Excellency Sir Arthur Lawley, in reply to a farewell address from the Ootacamund Municipal Council, presented on the 24th October, 1911, in which the drainage scheme was referred to :—

“ Now Ootacamund resembles many other good things in that she is not exempt from criticism. And I am afraid that criticism is sometimes tempted in its desire for effect to dispense with the companionship of truth. I was reading the other day some essays on politics by a distinguished Canadian writer, and the opening words of one of his essays run : It requires about 33 years to remove a false impression from the public mind, and about the same length of time to replace it by a correct one. Twice 33 is 66. Being of a sanguine temperament, I hope that it will be less than 66 years before the public mind will be disabused of the quite erroneous idea which has lately been assiduously promulgated in the Press, and is to me quite incomprehensible, that the sanitation and the drainage and the health of Ootacamund are in very parlous plight. I am no expert in sanitary matters, but I have made it my business to obtain the opinions of those who are, and who have carefully investigated the plans of the Ootacamund drainage scheme, and the manner in which the designs have been carried out, and they are unanimous in assuring me that the scheme as a whole is admirably conceived, and has been so far most efficiently carried out. Defects of detail, of course, there will be, as there must be in every scheme of this nature, but these, as they come into evidence, are being corrected, and I am confident that when complete you will have a most valuable asset conducing to the credit of those who introduced it, and the great benefit of those whom it serves. Various works of sanitation have been completed, others are in progress and others here, as in every other town in the world, are waiting to be taken in hand. Meanwhile, it is satisfactory to know that you can say, and say with truth, that public health is excellent.”

50. Our most important mofussil town to be provided with an up-to-date drainage system is Madura, with a present population of 136,000.

This town occupies a flat site principally on the right bank of the river Vaigai, which enters the sea near the island of Ráméswaram after a course below Madura of about 80 miles. A complete drainage scheme of pipe sewers on the separate system has been drawn up for this town, the estimated cost being 21 lakhs of rupees.

This scheme will, when constructed, serve a population of 171,460, so that the cost per head of present population will be Rs. 18, and of future population Rs. 13. Owing to the flat location of the town, the area to be drained, 931 acres, has been divided into six sections. Each section is provided with a pump well, so as to provide sufficient gradient for the sewers. Five of the sections pump into the heads of main sewers through independent rising mains, and these main sewers connect with masonry conduits which finally discharge the sewage through a screening chamber into the pump well of the main pumping station.

Each of the five smaller pumping stations are provided with oil-engines and centrifugal pumps, but the main pumping station is provided with direct acting steam plant which will pump the whole sewage of the city through a 24-inch cast iron rising main, five miles in length, to a sewage farm of 186 acres.

The soil at the site of this farm is red earth to a depth of three or four feet overlying gravel. It is proposed to utilise the sewage, pumped on to the farm, for growing sugarcane, and it is hoped to realise a net revenue of Rs. 250 per acre, which amount is based on local opinion and on the Poona experiments.

51. The sewers are designed to carry half-inch rainfall per day per house over an area of 1,000 square feet, in addition to the sullage based on the population of each house, which has been taken as composed of six people, and the water-supply, which is 15 gallons per head per day.

In addition to this provision for rain water, the limiting length of a 6-inch sewer has been made 300 feet, and beyond this length for the 6-inch sewer, a 9-inch sewer has been substituted, but to be laid with the 6-inch sewer gradient. On similar principles a 12-inch sewer has been substituted for a 9-inch and a 15-inch for a 12-inch.

These increased sizes of sewers are designed to be laid at the gradient of the next smaller size.

The object of this proposal is to have increased provision for carrying off heavy rain which may

fall within a short time. The result of increasing the size of sewers as mentioned above means a slight lowering of the velocity of the sewage, but this diminution is considered so small as not to practically affect the self-cleansing velocities in the sewers when half full.

52. The following are the gradients adopted in the scheme :—

Size.	Minimum.	Sewage velocity when pipe is half full or full per second.	Maximum.	Sewage velocity when pipe is half full or full per second.
4 inches	1 in 52	2½ feet.	1 in 21	4 feet.
6 "	1 in 100	Do.	1 in 40	Do.
9 "	1 in 190	Do.	1 in 76	Do.
12 "	1 in 295	Do.	1 in 120	Do.
15 "	1 in 415	Do.	1 in 165	Do.

The velocities have been calculated from Kutter's tables with a co-efficient of .013. If other formulæ are used, the velocities in the smaller sizes will be increased by 25 per cent. At least the minimum gradients are provided in the scheme except in the cases of some short lengths of unimportant sewers where it was found impossible to carry out rigidly the rules for gradients stated above. Such exceptions will occur in every practical scheme of drainage, and if efficient flushing is provided the unimportant exceptions can be accepted.

53. The greatest depths of sewers generally, except when a short length of ridge has to be passed through, has been fixed at 13 feet, that being the lowest sub-soil summer water level in the sandy sub-soil of the city.

54. The main section of the system will be ventilated by air inlets at the head of branch sewers, the only outlet being an extracting fan at the main pumping station where the foul air will be purified in a coke tower. The other five independent sections will be ventilated by air inlets and ventilating shafts as in the Ootacamund scheme.

55. Masonry flush tanks of 500 gallons capacity, and in some cases Field's automatic flush tanks, are provided in the scheme at the heads of all branch sewers, and wherever possible these tanks are filled with spill water from public fountains. Where piped water is not expected to be available 4-foot wells provided with a semi-rotary pump are proposed to be sunk in the sandy sub-soil of the streets so as to provide the necessary water for flushing purposes.

56. The latrines of the town will be converted into flushing latrines, and with the 20 dumping pits or pail depôts proposed will improve the existing conservancy arrangements.

57. The main pumping station is designed to be capable of pumping three times the dry weather flow to the sewage farm, the remainder of the rain water and sullage being surplussed from the main conduit into an irrigation channel which will lead away the surplus sullage to paddy fields.

58. The estimated annual pumping charges up to 1,927, are estimated at Rs. 49,630, out of which amount Rs. 37,500 is expected to be recouped by net income from the growing of sugarcane on the sewage farm, so that the net working cost of the scheme is estimated at Rs. 12,130.

59. The scheme, as described, is now under the consideration of Government.

60. A scheme for the drainage of the town of Vellore, population 40,000, has also been drawn up and is awaiting sanction of Government.

This scheme provides for open oval-shaped masonry drains, on each side of streets and conservancy lanes. These drains have been designed to be capable of discharging half-an-inch of rainfall per hour over the area draining into them.

The drains provided are intended to be constructed with a concrete floor and side walls of brick in lime mortar with cut-stone copings. The inside of the drains will be plastered with Portland cement to an oval shape. It is found cheaper in the end to use Portland cement for this plastering rather than use ordinary or kunkur lime mortar, the lasting properties of the latter not being good when used in sullage drains.

The scheme further provides for pumping the sullage up to three times the dry-weather flow on to an underdrained sewage farm of 44 acres, on which it is proposed to grow crops of sugarcane.

The estimated cost of the scheme is Rs. 3,67,764, which is at the rate of Rs. 9 per head of present population.

61. Drainage schemes for the towns of Trichinopoly (population 120,000) and Negapatam (population 58,000), Nellore (population 33,000) and Ellore (population 38,000) are at present being drawn up by me, and are expected to be under execution in the next year.

62. In addition to these towns drainage schemes for six other towns have been investigated and plans and estimates will be drawn up in 1912.

63. All of these schemes are, principally for financial reasons, on the open drainage combined system. The cost of drainage works in Madras can be approximately stated to be as follows in terms of present population :—

	Per head.
	Rs.
Pipe sewerage schemes involving sectional pumping by oil and steam plant with cast iron rising mains, septic tanks and sewage farm	18
Open drainage schemes with intercepting pipe sewers, oil or steam plant, cast iron rising mains, septic tanks and sewage farm	9
Open drainage schemes without pumping and discharge of crude sewage into the sea or tidal river	6

64. *Sewage disposal works in Madras.*—In many towns small sewage farms for disposal of sullage from local areas have been laid out. The largest sewage farm in use in the whole Presidency is that belonging to the City of Madras.

At this farm no septic tanks are in use or required at present although their construction will probably be found necessary in the future.

The soil at this farm being sea sand it forms an ideal means for sewage disposal. At Ootacamund where there is a septic tank the sewage farm in use is composed of heavy soil which requires to be underdrained.

In such cases where light and open soil is absent excellent results from the growing of grass for fodder may be achieved by top dressing the site of a farm with one or two feet of street rubbish so as to form a porous soil in which roots may spread easily and not be stunted in growth as in the case of grass grown on heavy or loamy soil. In this connection it may be remarked that in the case of certain sewage farms in Madras City, but now abandoned, as they were located too near dwellings, the growth of grass was phenomenal. These farms were located on sites which were in former times swamps or low ground but subsequently reclaimed by the dumping of street rubbish which was carted to the sites in conservancy carts.

65. Our experience in Madras is in favour of sewage disposal by the use of septic tanks and a sewage farm.

The septic tank should be designed in such a way that sludge may be periodically removed on opening a valve, thus causing the minimum of interference with the working of the tanks. What appears to be a cheap and suitable form of septic tank is a tank of triangular wedge section constructed with apex downwards, a slotted pipe being placed at the point of the wedge so as to receive the sludge which will be momentarily deposited. The sludge can be removed by the opening of a valve placed on the pipe, the requisite discharge head being provided by the liquid in the tank.

Tanks of this type can be cheaply constructed as a simple excavation, the sides to be puddled with clay and pitched with stone.

They may be left either open, or closed by a light corrugated iron roof.

66. *Programme of water supply and drainage schemes.*—At the beginning of this paper I referred to the fact that the number of water supply and drainage schemes awaiting investigation and the preparation of plans and estimates was 53.

A tentative programme of preparation and construction of water-supply and drainage schemes for the five years ending in 1917 has been drawn up and shows an apparent possible expenditure in the next five years on these schemes of 221 lakhs of rupees.

Out of this amount of Rs. 221 lakhs there is already available or will shortly be available plans and estimates for water-supply and drainage schemes of an estimated total cost of Rs. 76 lakhs.

The schemes to be drawn up in the next two or three years will be for the difference between 231 lakhs and 76 lakhs or 145 lakhs.

67. Many of these schemes, especially those for protected water-supplies, are urgently required by the local bodies. The number of schemes which can be drawn up and constructed is limited by the capacity of the Sanitary Engineer's establishment and by that of the Public Works Department to carry out the construction.

68. There is also to be considered the even more important question as to whether the local bodies which cannot bear the entire cost of sanitary works should be assisted by grants from the ordinary revenues or from special sanitary loans. If from the former, then the construction of sanitary works must necessarily be retarded and in lean years it might so happen that, when the greatest need was felt for certain sanitary works, the ordinary revenue was already ear-marked for the resulting consequences of the lean year.

69. If sanitary works are to be advanced in mofussil towns at that rate which an inspection of this towns seems to show is desirable, it appears to be advisable that a programme of construction should be prepared for a period of five or ten years ahead and to arrange for the supply of the necessary funds by a large and special sanitary grant to be given by the Government of India.

70. The construction of any sanitary work the cost of which bears a reasonable comparison to similar works carried out elsewhere should, I think, be determined not by the amount of financial assistance which can be given without dislocation of other demands, but by the actually proved necessity for the sanitary work, from the point of view of the public health of the town in question.

(Signed) W. HUTTON,
Superintending Engineer,
Sanitary Engineer to Government.

MADRAS;
The 10th November, 1911.

ANNEXURE 1 TO APPENDIX 8.

From—W. Hutton, Esq., A.M.I.C.E., Sanitary Engineer to the Government of Madras. To—The Chairmen, Municipal Councils, Vizagatapam, Cocanada, Kurnool, Adoni and Vellore. Circular No. 3443, dated the 5th November, 1909.

In connection with the printed rules for starting and working filters issued by this department for your guidance I have the honour to request that the following instructions may be carefully observed :—

- (1) *About starting filters after cleaning.*—Filtered water should invariably be admitted from the bottom upwards until the water rises six inches above the surface of the sand. The rate of admission should be the same as the safe rate of filtration for the filter. Then unfiltered water should be admitted through the ordinary inlet to the filter until the water rises to the full height in filter. The water should then be allowed to remain undisturbed for a period of 24 hours at the end of which period the scour valve should be slowly opened to let out all the water thus allowed to settle until the water level in the filter stands six inches over the sand layer. While the scour is kept open, care should be taken that the slimy layer formed on the top of the sand layer is in no way disturbed. As this slimy layer is found to play an important part in the efficient working of sand filters the process of admitting water into the filter, allowing it to settle itself quickly for 24 hours, then withdrawing by the scour valve without disturbing the slimy layer even very slightly, should be repeated as often as necessary until the slimy layer formed on top of the sand is about $\frac{1}{2}$ inch thick. The filter is then ready for working for the town supply.

- (2) *About sand for filters.*—The sand used should neither be very fine nor very coarse. Its uniformity co-efficient should be somewhere between 2 and 3. The sample proposed for use should first be sent to the Sanitary Engineer to Government for examination and advice as to what treatment it should receive before using. If it is found necessary to screen the sand the Council may request the Sanitary Engineer to indent for such screens as he may decide is necessary for the purpose.

ANNEXURE 2 TO APPENDIX 8.

From—W. Hutton, Esq., A.M.I.C.E., Sanitary Engineer to the Government of Madras. To—The Chairman, Municipal Council, Vizagapatam. No. 3676, dated the 29th November, 1909.

During my inspection on the 19th instant of your headworks I found that clean sand only to a depth of 4 inches had been laid down on filters Nos. 1 and 2 over a layer of dirty sand.

I have, therefore, the honour to invite your attention to the printed regulations issued from this office for the working of sand filters and to my circular letter No. 3443, dated 5th November, 1909, and to request that you will be good enough to see that instructions contained therein are carefully attended to if the sand filters are to be of any practical value in supplying the town with potable water.

To emphasise the need for occasional proper cleaning of drainage and filtering medium in sand filters I will repeat the procedure to be adopted for cleaning such filters. As a rule, every filter should be cleaned at least once every two years or oftener if found necessary. When a filter has been found to clog up fast, that is, when the interval between ordinary cleanings is much less than usual, then the filter should be thoroughly overhauled and relaid. First the dirty water should be run out by the scour valve provided for the purpose. Then the sand should be carefully removed, as soon as it is dry and thoroughly washed in a sand box or other device preferably with water under pressure entering the sand box from the bottom. The sand thus cleaned should be carefully dried and screened with screens recommended by the Sanitary Engineer and stacked near the filter in different heaps according to their grade of coarseness. Any sample picked up at random from the heaps when put into a tumbler of water should impart no turbidity to the water.

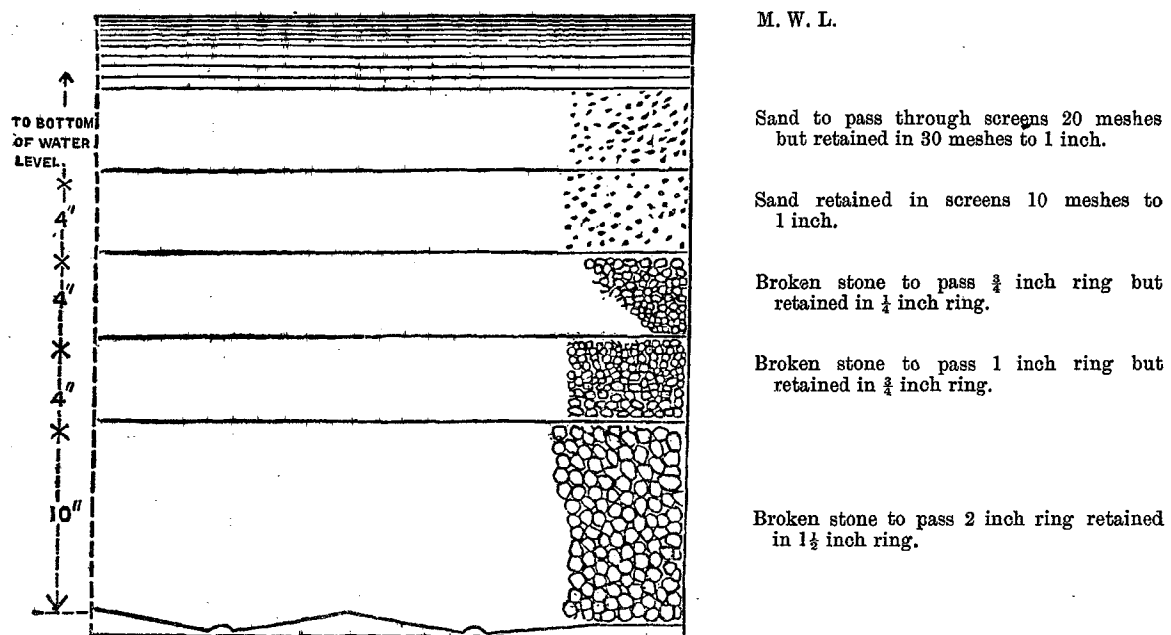
Then the drainage layers should be dealt with as follows:—

Immediately the superimposed sand is removed the drainage layers should be well soaked in water. While they are being thus soaked they should be turned over by a rake, shovel or other contrivance so as to facilitate the removal of deposits or any foreign matter with which they may have become coated. The drainage layer should then be well rinsed in clean water, dried and stacked in heaps according to sizes. Any sample picked up at random and thrown into a bucket of water should impart no sign of turbidity to the water.

The walls, floor, under drains of the filter should then be carefully scrubbed, washed, limewashed and exposed to the action of the sun for a couple of days and re-washed with clean water.

While the filter is thus being treated, advantage should be taken to examine and put right all the inlet and outlet, scour and overflow valves, screens and other appendages.

Then in relaying the filter the drainage layer and sand shall be laid as in sketch below:—



If the materials removed from the filter be found insufficient after washing then new material should be procured and treated as if such material had been removed in the first instance from the filter in a dirty state.

The filter should then be re-started in strict accordance with special instructions contained in my circular letter No. 3443, dated 5th November, 1909.

FILTER BEDS.

Rules for starting and working filters.

I.—NEW FILTERS.

Filling with water.—After completion of the filters the unfiltered water should be run slowly on to the surface of the sand, through the copper gauze inlet screen, so as to fill up the filter bed with water.

The rate of filling should not exceed 4 inches per hour, and care should be taken to avoid scouring the surface of the sand by a rush of water from the inlet chamber.

If the total depth of the filter bed from bottom to top of water level is 8 feet it should take 24 hours to fill the bed.

If the water is observed to be rushing too fast on to the sand surface, the inlet valve should be regulated so as to reduce the flow and scouring of sand thus prevented.

Statement showing the towns in the Madras Presidency where water-supply schemes have been completed or are in progress (Madras City omitted).

Num- ber.	Name of Town.	Population when scheme was drawn up.	Population for which the scheme was designed.	Number of gallons and supply for which works were designed.		Actual or estimated cost.	Cost per head.		REMARKS.
				Total.	Per head.		Popula- tion in column 3.	Popula- tion in column 4.	
						Rs.			
1	Adoni	26,212	30,000	300,000	10	1,57,319	6	5.2	Gravitation: Storage tank, filter beds and service reservoir.
2	Bezwada... ..	24,224	40,000	600,000	15	3,11,790	12.9	7.8	Pumping: Wells and service reservoir.
3	Cocanada	40,685	50,000	750,000	15	5,02,342	12.4	10.5	Pumping: Storage tank and filter beds.
4	Conjeeveram	42,561	56,000	840,000	15	2,69,231	6.3	4.8	Pumping: Infiltration gallery and service reservoir.
5	Coonoor (Hill Station).	6,049	7,500	150,000	20	1,85,394	30.6	24.7	Gravitation: Impounding reservoir and service reservoir.
6	Cuddapah	18,982	20,000	200,000	10	1,17,615	6.2	5.8	Pumping: Gallery and service reservoir.
7	Dindigul	16,000	22,000	220,000	10	1,30,150	8.2	6.0	Gravitation and pumping: Gallery and service reservoir.
8	Gudiyattam	21,335	25,000	150,000	6	81,000	3.8	3.3	Pumping: Infiltration gallery and service reservoir.
9	Guntur	30,833	30,000	450,000	15	2,55,471	8.3	8.5	Gravitation: Springs and service reservoir.
10	Kurnool... ..	24,523	30,000	450,000	15	2,63,667	10.75	8.8	Pumping: Canal, storage tank and service reservoir.
11	Madura	87,426	100,000	1,500,000	15	3,94,738	4.5	3.9	Pumping: Submerged filter bed.
12	Nellore	32,040	35,000	525,000	15	1,65,562	5.2	4.7	Pumping: Infiltration gallery and stand pipe.
13	Ootacamund (Hill Station).	10,000	20,000	400,000	20	5,75,836	57.5	28.8	Gravitation: Impounding reservoirs.
14	Salem	70,621	80,000	1,200,000	15	9,10,535	12.9	11.4	Gravitation: Storage tank and service reservoir.
15	Tanjore	54,055	60,000	900,000	15	4,47,420	8.3	7.4	Pumping: Submerged filter bed, service reservoir.
16	Tirupati	14,242	24,000	360,000	15	2,31,000	16.2	9.6	Gravitation: Gallery and service reservoir.
17	Trichinopoly	88,715	88,000	1,320,000	15	7,68,251	8.7	8.7	Pumping: Gallery and service reservoir.
18	Vellore	44,950	50,000	750,000	15	3,22,860	7.2	6.4	Gravitation: Impounding tank, filter beds and service reservoir.
19	Vizagapatam	34,487	40,000	600,000	15	4,71,804	13.7	11.8	Gravitation: Impounding reservoir, filter beds and service reservoir.
<i>Water-supply schemes under construction.</i>									
1	Berhampur	25,745	30,000	450,000	15	3,11,000	12.1	10.3	Gravitation: Storage tank, filter beds and service reservoir.
2	Chidambaram	19,909	30,000	450,000	15	3,97,650	20.0	13.3	Pumping: Channel, storage tank and service reservoir.
3	Periyakulam	17,960	24,000	360,000	15	1,62,670	9.1	6.8	Pumping: Infiltration gallery and collecting reservoir.
4	Vizianagram	37,270	50,000	750,000	15	4,86,790	13.1	9.7	Pumping: Infiltration gallery and service reservoir.
5	Kodaikanal (Hill Station).	1,912	3,500	70,000	20	82,700	43.2	23.6	Gravitation: Impounding reservoir.
6	Negapatam	57,190	82,250	1,233,750	15	7,46,760	13.0	9.1	Pumping: Infiltration gallery and service reservoir.

OFFICE OF SANY. ENGR. TO GOVT., CHEPAUK, MADRAS;
The 10th November, 1911.

(Signed) W. HUTTON,
Superintending Engineer,
Sanitary Engineer to Government.

APPENDIX 9 to No. 4.

VILLAGE SANITATION.

Sanitation in rural areas of the Madras Presidency is the duty of Taluk Boards and is administered by the Madras Local Boards Act. The result achieved in the sanitary improvement of villages during nearly half a century is disappointing. This is due not to any lack of effort or interest on the part of the authorities responsible, but to the ignorance and ingrained conservatism of the people to be dealt with. The scepticism and apathy with which sanitary reform had in the past been regarded have to a great extent disappeared, and there can be no doubt that very laudable efforts are now made by local bodies to improve the sanitary condition of villages by attention to conservancy and the improvement of water-supply and drainage. There are obstacles in the way of the achievement of this and these are :—

- (1) Lack of funds.
- (2) Absence of correctly organised and trained sanitary staffs.
- (3) The inadequacy of the law to enforce sanitation.
- (4) The failure of the people to co-operate so as to render the measures adopted a success.

The first three are by no means insuperable and could be overcome by some organised plan in each district so as to secure the greatest advantage from the funds available.

The apathy of the people is the stumbling block to all progress.

Valuable suggestions have from time to time been made by many sanitarians as to what is best to be done, but the practical outcome of all is, that during the half century this work has been going on, the advance in rural sanitation has been so extremely limited that according to the latest returns furnished there were during 1910 only 595 towns and villages conserved out of a total of 42,852 in the Presidency, that is, 98·6 per cent. of towns and villages still remain uncared for by a system of conservancy. In fact, compared with 1909 these figures show a retrograde movement inasmuch as conservancy arrangements were during 1910 withdrawn from three towns and villages. The sanitary plant is such as to be of very little benefit and the staff employed inadequate; they are not organized in correct proportion to the area or population served nor are they under skilled supervision.

During the last 20 years increased attention has been paid to sanitation both by Government and local bodies not only in the matter of funds, but in the introduction of trained staffs such as sanitary assistants to District Medical and Sanitary Officers and Sanitary Inspectors, thus forming the nucleus of a future sanitary service. It is, however, much to be regretted that these subordinates are employed to a very limited extent in the rural parts of the Presidency.

In every village so much has to be effected that general directions are sure to be disregarded and in fact would be beyond the financial resources of most districts.

There can be no doubt that it can best, indeed, only be done step by step with some definite object in view, but with the clear understanding that in each district there should be, every year, a fair amount done either in the line of permanent improvement of some kind or in the establishment of conservancy operations.

The only way of doing anything at all seems to be to select in each the most urgent and easily remediable need and have it carried out.

There are villages where all-round sanitation is urgently demanded, viz., those which are the perennial haunts of cholera. More good would come by concentrating efforts on these than in making spasmodic attempts to conserve others that are not marked by so heavy a death-roll.

A beginning might be made in each district, in consultation with the medical officer as to what is most urgently needed and most easily set right, and the villages nearest to large towns and cantonments would properly first engage attention.

The rectifying of one insanitary condition is not enough to banish preventible causes of disease and of physical degeneration, but it would help; and as everything desirable cannot be done at once, it seems better that efforts be directed to what is immediately practicable.

WATER-SUPPLY.

The water-supply in most districts furnishes a worthy object for the expenditure of money and of the best endeavours of all concerned in it. Till the people in every district can be said to be supplied with pure drinking water, there need be no difficulty in laying out to the best advantage the full amount of the allotment for sanitation, much of which is now too often left unexpended. The chief sources of water-supply in rural areas are wells, tanks, rivers, streams and irrigation channels. These are subject to all manner of contamination that it may safely be said that in no village do the people drink a safe drinkable water. Of course it would be impossible to provide a protected water-supply to every town and village and we must for years to come content ourselves with improving existing sources and conserving them.

Protected water-supply schemes are under consideration in several of the Unions, but where these are not possible the provision of wells on standard designs and many of them on clean sites and the improvement of existing wells seem to offer the best solution to the problem of water-supply in villages. All efforts and expenditure should therefore be concentrated towards the attainment of this object. Tanks should be improved by so guarding them as to prevent direct access to the water in the tank. The Sanitary Engineer to Government in Madras Presidency has drawn up plans and specifications showing how this could be effected. The conservation of rivers, streams and irrigation channels seems to be a hopeless task. The method usually adopted is to set apart portions of a river, stream or irrigation channel for drinking purposes and appointing watchmen to prevent contamination, but a more useless way of spending money cannot be imagined. The guarding is merely nominal and, moreover, where the river is the drinking water source of several villages along its course, the villages lower down must necessarily drink contaminated water coming from the portion of the river set apart for inferior purposes in the villages higher up. In this way cholera is easily spread from village to village as is very frequently observed. If an adequate number of wells are provided,

resort to rivers will be avoided so that rivers and streams will soon cease to be drinking water sources. Where funds permit wells should be covered and provided with a pump elevated cistern and taps.

- Type design for wells with explanatory remarks.
- Type design for hand pumps with explanatory remarks.
- Type design for shallow well with explanatory remarks.
- Type design for deep well with explanatory remarks.
- Type design for protecting tanks.

DRAINAGE

To introduce a regular system of drainage, scattered as are the towns and villages, would be an insuperable difficulty, and involve an immense expense beyond the means of any district. The existing side cuttings generally to carry off storm water are adequate enough if kept clear of obstructions for the free flow of water. Where these drains pass near houses they should be rivetted. Household sullage should be disposed of by discharge into fields.

Those parts of a village on lower level to which all or nearly all the drainage of the village gravitates should be provided with a masonry drain to carry the sullage away from the foundations of the houses and convey it to the fields beyond. This I consider is an object of simple improvement on which public funds might be well spent.

Drain from well or water from drinking fountain :—

1. Cesspool.

Type design.

2. Infiltration trench with remarks.

CONSERVANCY.

Next to water-supply, conservancy, both public and domestic, should receive special attention. There can be no doubt that the accumulation of filth of all kinds in the streets and backyards and compounds of houses, the housing of cattle with human beings, &c., form the foci of many diseases. I would therefore urge that, in order to effect a reform in this direction, every effort for the present should be made towards the proper conservancy of our towns and villages. The main evils can only be grappled with, in detail, village by village, and as a beginning I would suggest that a suitable town or village (having a dispensary) be selected by the President or District Medical and Sanitary Officer in each taluk of a district and made the basis of operation. It should be the head-quarters of a Deputy Collector or Tahsildar, who took an interest in sanitation, and was popular with the people. The town or village having been thus selected, I would recommend the promulgation and observance of the following effective and easily worked rules as to its conservancy, which would entail no money expenditure, as it would be within the power of the villagers themselves to give effect to them. The enforcement of the rules and their observance by the people should be entrusted to the Deputy collector or Tahsildar who should be enjoined to obtain the co-operation of the people by explaining to them the various improvements proposed and by persuasion enlist them in the work of protecting their own health.

First.—Certain fixed sites should be selected on the outskirts, at least about 200 yards distance from the town or village, apart from any source of drinking water-supplies. These should be defined and protected by a low boundary wall or hedge and formed into depôts. All the sweeping and filth of every description from the streets, backyards and compounds of houses should be carried to, deposited and stored in these depôts. They should be under the supervision of the Tahsildar or Deputy Collector or any responsible person the President may think advisable to appoint. The mass of filth, rubbish, &c., thus collected should, under the superintendence of the Deputy Collector or Tahsildar, &c., be apportioned off to the several contributors when required by them as manure for their fields, which will generally be at the commencement of the cultivating season, or sold by auction.

The filth and rubbish, &c., from the backyards and compounds of houses should be carried to the depôts by the owners of the houses themselves, and in the event of their failing or refusing to do so the law appropriate to the case should be enforced.

This system has been adopted in other parts of India with decided advantage as to cleanliness, salubrity, and the healthiness of the villages; and what has been accomplished in one place cannot surely be impracticable in another.

Second.—All the cattle should be removed from the interior of backyards, &c., and housed outside the village or town. No doubt this measure will be met by violent opposition on the part of owners of cattle, but the constant danger to health inseparable from this practice necessitates their removal. The ryots in some places may be induced to build homesteads on their land for housing the cattle. At any rate, some provision should be made for stalling animals in other places than outside houses and backyards. If possible they should be penned on the fields or kept on some open ground within the village.

Third.—No one should be permitted to perform offices of nature in the village street, lane or open space. Some pieces of ground outside the town—not near any well or drinking water source—should be set apart where people should resort for the purposes of nature.

Trenches 1 foot broad and 1½ feet deep and as long as required should be dug in the places set apart. Every person using the trench should, by notice on a board put up in a conspicuous place, be directed to cover up his own filth. As soon as one piece of ground has been so used up all over, another site should be selected and the manure ground ploughed and cropped.

Villagers in better circumstances may perhaps object to go to the places set apart for the purposes of nature; such persons should then be directed to have their private privies daily cleaned out by sweepers employed by them for the purpose. Or arrangements might perhaps be made for their convenience, as is done in other parts of India, to have a group of privies constructed outside the compounds of houses and provided with door and lock and key to be used only by owners. These privies should be kept clean by scavengers employed and paid for by the owners themselves. Type design latrines with remarks.

Fourth.—All ruined dwellings should be removed and the sites levelled, all vacant sites cleaned and enclosed by owners, all useless jungle should be removed and prickly-pear and overgrown weed and shrubs cleared away by the villagers at least once in every six months.

There should be no difficulty in so arranging matters as to obtain spaces beyond village limits for the storing of manure, housing of cattle, and for offices of nature.

The example of an improved town or village will tell upon others in its vicinity and create a general conviction among the people of the necessity of sanitary reform.

Much good might be done towards sanitary reform by the distribution of a few simple rules to the village headmen on the conservancy of their villages and cleanliness of their dwelling houses, &c.

The tahsildar or medical subordinate attached to a dispensary (should one exist) should inspect and report weekly or monthly on what is being done, care being taken by the inspecting officers not to prejudice sanitary work; and at the end of every month or quarter the President should report to the Sanitary Commissioner as to how the system is working.

I feel confident that if what I have suggested above be adopted as an experimental measure in one or more villages in each district, it will prove successful, and the vexed question of village sanitation would, in one important respect at least, *i.e.*, conservancy, be satisfactorily solved by the extension of the system throughout the Presidency.

(Signed) W. A. JUSTICE, *Captain, I.M.S.*

APPENDIX 10 to No. 4.

NOTE ON THE MILK SUPPLY OF LARGE TOWNS IN INDIA.

The very unsatisfactory state of the milk-supply of large towns in India has long been realized, but it is only within the last few years that the subject of improving it has received much attention.

It is true that there are Government dairies in many cantonments, but these are for the benefit of troops, and their existence may be considered as an admission by the military authorities of their failure to obtain satisfactory milk from indigenous agencies; for it may be safely assumed that they would not otherwise have resorted to the costly expedient of dairies under European management for the milk-supply of troops. It is also true that in some large towns, with a considerable European population, dairies have been established by private enterprise, in which some attempt, often a very feeble one, is made to handle milk by Western methods. These, however, cater for the well-to-do classes who alone can afford to pay the high prices charged for milk at such establishments.

Further, legal provision exists, in the Municipal Acts of most provinces, for the regulation of the milk trade, and some large municipalities have framed milk bye-laws, based upon those in force at home. Even where such bye-laws exist, however, many of them are inoperative or nearly so, and this for at least two cogent reasons; one is the want of the necessary staff to enforce compliance with the bye-laws, and the other the apprehension lest such enforcement should cause a rise in the price of milk out of proportion to any improvement in its quality.

The problem which thus still confronts the civil sanitarian in India is how to obtain from indigenous agencies, namely, the *guala*, a reasonably pure and wholesome milk supply at a price within the means of the ordinary inhabitants of Indian towns. It is unnecessary, in a note intended for members of an Indian sanitary conference, to describe the conditions of urban milk-supply which it is our duty to attempt to improve.

Most of us are familiar *ad nauseam* with examples of milch cattle crowded into low, unventilated huts, fed upon garbage and milked in urine-sodden byres. We also know the dirty hovels in which milk is stored, the battered brass milk-vessels "cleaned" with mud from the byres, and have seen milk carried long distances in open cans with a wisp of dirty straw floating in it to prevent spillage. We have also had experience of milk obtained from unhealthy animals, or shamelessly adulterated with skimmed or churned milk or diluted with water from any filthy source.

The problem of improving these conditions is certainly a difficult one, and its difficulty explains why it has aroused less interest than its importance deserves, and justifies the practical wisdom of the Indian consumer in refusing to drink milk unless it has been boiled.

It may, however, afford us some encouragement to reflect that conditions very similar to these just mentioned were common at home not so very long ago, and that once they received the earnest attention of public health officers improvement was very rapid.

I do not, of course, suggest that we can expect a similar rate of progress in India, nor do I think that success can be attained by similar means. For at Home it is largely by legislation, backed by enlightened public opinion, that the purification of the milk trade has been effected, while from what has been stated above it will be apparent that little is to be expected from resource to stringent bye-laws in India, at any rate for the present. We shall, I think, for some time to come, obtain better results from the education, both of public opinion and of the *guala*, as to the advantages of clean milk, and from the encouragement of voluntary reform, than from resort to legal powers, though this will be necessary for dealing with fraud and wilful obstruction.

One way that has been suggested for dealing with the problem we are considering is that municipalities should establish dairies similar to those in cantonments. I gravely doubt, however, if the intrusion of municipalities into the milk trade would be a wise step. For it would involve large initial expenditure without any prospect of successful competition with the *guala* except at a considerable recurring loss. Moreover, in order to meet the competition so created the *guala* would undoubtedly resort to still further adulteration of his milk.

If, on the other hand, municipalities were to try to make their dairies self-supporting by charging high prices for milk, they would only benefit the well-to-do classes, whose wants, as has been seen, are already catered for in some large towns. Such action would also certainly cause a general rise in the price of milk. In either case, therefore, the interests of the ordinary consumer are more likely to be injured than advanced, while the main problem—that of reforming the *guala*—is left almost untouched.

As a preliminary step towards obtaining a cleaner milk-supply, I would suggest the imposition of a tax upon all cattle housed within a town. It might be desirable to exempt from this tax milch

cattle kept for purely private purposes, or those housed within certain specified areas, but the main object of the tax would be to exclude, as far as possible, all cattle from towns, in the interest both of the animals themselves and of urban sanitation.

It would be necessary to arrange for the accommodation of the milch cattle so displaced, and I think the best way of doing so would be by inducing dairymen to keep their herds in the neighbourhood, within a few miles of towns, by offering them land, cowsheds or dairies at low rentals. The expenditure on such a scheme need not be great, especially in the case of towns possessing spare lands. It might eventually become remunerative, as when this arrangement was firmly established and its advantages recognised by dairymen it would be possible to charge higher rents. In any case I think such a scheme would be a more suitable object for municipal expenditure, and would afford a far better prospect of improving the milk-supply than would the establishment of municipal dairies.

Such a system would greatly facilitate the inspection of milch cattle, their accommodation and food, the arrangements for the storage and transport of milk and the manufacture of butter and other milk-products.

The low rentals charged should also attract dairymen from a distance; this would bring them also under inspection and would have the further advantage of shortening the carriage of milk, a very important one in a hot and dusty country.

It might be objected that the sudden displacement of milch cattle from a town might dislocate the milk trade. There is, however, no necessity for sudden action, ample warning should be given and accommodation for the displaced animals should be prepared beforehand.

There is, moreover, little danger of any serious dislocation by this means of the milk trade of large towns, in the Punjab at any rate. As it is, a considerable proportion of the milk-supply of towns like Lahore and Amritsar comes from outside.

The trouble is that it is brought in from long distances, as great as twenty miles, mostly by road, and under conditions already alluded to, and it is this which it is desirable to avoid.

To further encourage the reform of the urban milk trade it would be desirable to provide milk vessels and appliances of approved pattern at or below cost price, or to offer subsidies, prizes or certificates to dairymen complying with municipal requirements, or to grant them special facilities for the sale of milk in towns such as the abatement or remission of octroi, or the provision of carriage or of milk shops.

Inasmuch as the urban milk trade is largely carried on by agriculturalists its improvement is a matter which concerns District Boards and provincial Agricultural Departments.

District Boards might therefore be expected to co-operate with municipalities in some of the measures already mentioned, such as the provision of land or cowsheds for dairymen at low rentals. Agricultural Departments could also render effective help by undertaking the training of *gwalas* in modern methods of milk production, and by improving the breeds of milch cattle.

I may say that the Agricultural Department of the Punjab is already turning its attention to this subject.

So far I have been chiefly concerned with the production of clean milk, and by this I mean not only milk which has been protected from ordinary filth contamination, but which has also been obtained from healthy animals.

It remains to consider the question of the adulteration of milk.

This, although less difficult than that of obtaining clean milk, is not quite as easy as might be supposed. For except in a few large cities there is no one who can make accurate tests of milk and without such tests prosecutions for the sale of adulterated milk would have little chance of success.

Moreover, there exist at present very few observations on the composition of the milk of Indian cows and buffaloes, and it is necessary, before resorting to law for the punishment of fraudulent milk-sellers, that standards should be available with which to compare tests of suspected milk.

Milk standards would probably be necessary for different parts of India and for different seasons; for it is known, for example, that milk yielded during the rains is poorer in fat than at other seasons.

Meanwhile, in the absence of such tests and standards, the best way of dealing with gross adulteration of milk would be to require all milk-sellers to be licensed and to make the sale of pure and unadulterated milk a condition of the grant of a licence. Any serious infringement of this condition could thus be dealt with by withdrawal of the licence, without resort to legal proceedings, as it would be easy, by simple tests, such as the comparison of the specific gravity of milk with the amount of cream obtained from it on standing for, say, six hours, to detect any gross adulteration.

I have not dealt with butter or other milk products, for their improvement will follow, as a matter of course, upon that of the milk-supply.

(Signed) E. WILKINSON, *Lieutenant-Colonel, I.M.S.*

APPENDIX 11 to No. 4.

IMPROVEMENT IN THE AGENCY FOR THE REGISTRATION OF VITAL STATISTICS.

While ascertaining the causes of death during my investigation of malaria in the Central Provinces, I was much impressed by the amount of information regarding infantile mortality which could be derived by questioning the native *dhais*.

This is a source of information relating to vital statistics which is at present little, if at all, utilized.

In rural areas there is practically no inaccuracy in the numerical return of births and deaths; the unit is too compact and the event of a birth or death is sufficiently known and isolated not to escape record; there is also, to a certain extent, fear of police enquiry and interference should any concealment occur.

In such areas the village kotwal (the local registration officer) returns the great majority of infantile deaths as being due to fever; even infants dying as soon as 1 to 2 hours after birth are reported as the victims of fever: a few deaths are also credited to "dabba" and to "sukkhi."

A few questions to the village *dhais* throw considerable light on these reported fever cases ; it is found that hereditary syphilis, convulsions, neglect or exposure, etc., etc., have a large share in the mortality factor and that the greatest inaccuracy prevails as regards the recorded length of time the child lived after birth.

The *dhais* know the history of each and every case and usually have no hesitation in supplying details.

In urban areas, on the other hand, the vital statistics are unreliable, not only from the point of view of "causes of death," but also as a numerical record, more especially in connection with births. The inclusion of the *dhais* in the reporting agency of towns will, therefore, bring about improvement in two directions :—

- (i) In the calculation of the birth-rate.
- (ii) In the ascertained causes of infantile mortality.

To give an instance of the advantage of utilizing the *dhais*, Burhanpur City, of 33,000 inhabitants, gave a yearly birth-rate sometimes slightly in excess, but mostly considerably below, the death-rate.

In 1909-10 I advocated the use of *dhais*, as a reporting agency and the adoption of the plan by the municipality in the present year has been followed by an increase of 12 per mille in the annual birth-rate.

I would suggest that steps be taken to include the *dhais*, in rural areas, as part of the provincial reporting agency ; their reports could be made to the local registration officer (the kotwal in the Central Provinces), the inducement being a small annual reward.

In municipal areas the Committee could make similar arrangements. If adopted, this plan would have the advantage of effecting the registration of *dhais*, a preliminary to any real reform in the domestic sanitation of the Indian home.

The *dhais* would become more accessible to the efforts which are at present ineffectually made to improve their unskilled methods and somewhat lessen the infant mortality of the country.

(Signed) W. H. KENRICK, *Major, I.M.S.,*
Officiating Sanitary Commissioner,
Central Provinces.

APPENDIX 12 to No. 4.

NOTE ON THE VERIFICATION OF VITAL STATISTICS.

It has long been a matter of comment that although the numbers of births and deaths recorded in India are very fairly accurate, the reported causes of mortality are very far from correct.

This defect is, of course, chiefly due to the want of accurate diagnosis, most persons in India dying either without any medical treatment at all or with only that of village practitioners of indigenous system of medicine to whom accurate diagnosis is a superfluity as well as an impossibility.

Wilful mis-statements as to the causes of deaths are sometimes made, as for example, when deaths from cholera or plague are reported as having been due to some other cause in order to avoid interference. Such mis-statements, however, are of but slight importance from statistical point of view, for their aggregate is not great and they are often refuted by the unmistakable evidence of serious epidemics or can be corrected by consideration of the local death returns for a series of years. It is thus, for example, that a high mortality in a Southern Punjab town in May, reported to have been caused by "fever," can be ascribed, not to malaria, but to plague.

There are many agencies for checking the number of births and deaths reported. The most important of these is the vaccination staff, the members of which, in order to ascertain the number of children which should be available for vaccination, have to examine birth and death registers and to make enquiries as to their correctness.

In the Punjab there are also Divisional Inspectors of Vaccination and Vital Statistics whose duty it is, besides inspecting the work of the vaccination staff, to make careful examination of the birth and death-registers, to check them by enquiries (chiefly from *baidis*, *hakims* and *dhais*) and to report any omissions or mistakes that they may discover. These men, however, are only promoted vaccinators without any medical knowledge, and they are thus of little or no use for ascertaining the causes of death. Further checks on the number of deaths reported are provided in some towns by the records maintained at burial grounds and burning ghats or by the registration of funerals passing octroi barriers, but these too are of little or no use for ascertaining the causes of deaths and except by special enquiries instituted in connection with epidemics there is, in the Punjab, no means of ascertaining the true causes of mortality.

It might be thought that the examination of hospital and dispensary registers might show the prevalent diseases in any given locality and thus furnish some idea of the causes of mortality. This, however, is the case to only a very limited extent and malaria is almost the only disease the mortality from which is reflected in hospital and dispensary registers. This can be understood when it is considered that patients with acute diseases such as cholera, plague and small-pox, rarely, if ever, resort to hospitals for treatment, except in large towns.

Further, I have found, when examining such registers for evidence of the prevalence of particular diseases such as tuberculosis, that great fluctuations occur in the entries which can only be accounted for by some external cause such as changes in the medical staff. This may result either in changed diagnoses or in increased or diminished attendances for certain classes of ailments according to the reputation of the medical officer.

It is possible that the proposed registration of medical practitioners in India, when carried into effect, may result in some improvement as regards our knowledge of the causes of mortality. For it is to be presumed that registration will carry with it the obligation of furnishing certificates of the

cause of deaths, and these should be valuable as data for checking the causes of uncertified deaths. It will, however, be long before such data are available outside the larger municipalities and it will thus be necessary to employ some special agency to enquire into the causes of rural mortality.

In the Punjab the nucleus of such an agency might be supplied by the appointment of Assistant Surgeons or Sub-Assistant Surgeons as Divisional Inspectors of Vaccination and Vital Statistics, in place of promoted vaccinators, and this is a step I have under consideration. It would, however, only deal with the fringe of the problem, and it is chiefly with the object of ascertaining what is being done in other parts of India and of initiating a discussion on the subject that I have prepared this brief note.

(Signed) E. WILKINSON, *Lieutenant-Colonel, I.M.S.*

APPENDIX 13 to No. 4.

REGISTRATION OF VITAL STATISTICS.

In the United Provinces the returns of vital statistics are tabulated separately for town and rural circles, each comprising from 10,000 to 15,000 inhabitants, and separate registers are kept for births and deaths. Both these registers give the date of the occurrence, the sex, the name of the father or head of the household, and the religion, and, further, in the case of deaths, the age and the cause of death are also shown. For registration purposes, whole-time officers are not, as a rule, employed and, generally, the writer at each police station is the recording agent except in the hill tracts where the village accountant takes his place. These officers obtain their reports in rural tracts from the village chowkidars who report weekly, in the municipalities and cantonments from the police who report daily and also from sweepers and the heads of households or the managers of public institutions, and in the hill tracts from the village headmen. Monthly, the registration officers submit abstracts of their registers of births and deaths for each sub-circle to the Civil Surgeons of their districts and by the latter officers the abstracts are tabulated and forwarded to the Sanitary Commissioner for check and publishing in the Gazette.

For the purposes of checking and testing the registration several agencies are employed. In some municipalities and cantonments special inspecting registrars are entertained, but, as a rule, the work is done by the Civil Surgeons. In rural areas the revenue staff, the police, the officers of the medical and sanitary departments, and the vaccination staff, all assist.

The whole system has the very decided merits of simplicity and cheapness and it is generally admitted that the returns, so far as total registration is concerned, are reasonably accurate. With regard to births this is practically all that is required, but I think you will all agree with me that in the case of deaths we want much more and it is here the system fails. The registration of the causes of death is very defective, and even the statements as to age, sex, place, and date are frequently far from correct. Most persons die in India either without any medical treatment at all or with only that of the village *baid* or *hakim*. No accurate diagnosis of the disease is made and to this are probably due most of the errors as to the causes of death. This, however, will not account for the want of differentiation between such easily recognisable and well-known diseases as fever, cholera, small-pox, diarrhoea and dysentery, &c. In such cases some other explanation is necessary and this, it appears to me, is to be found in the carelessness of the officials who do the actual registration. These men have little interest in the accuracy of the returns which they consider as something apart from their regular duty and of little importance—an opinion which is fostered by the fact that the checking and supervision are left to busy officials whose time is otherwise fully occupied.

To remedy these defects it would be necessary to institute a separate paid agency for the registration, and another for the checking, of vital statistics. In rural tracts, I may say at once, this would be out of the question at present. The labour and cost would be enormous and the results far from commensurate with them. The present system seems the only one feasible supplemented in the case of particular enquiries by detailed verifications by special officers. As the statistics from such verifications increase, it should also be possible to strike general averages for particular tracts quite accurate enough for all practical purposes.

In the municipalities and the larger towns, however, the position is quite different. Complex sanitary questions are now constantly cropping up and large improvement schemes involving heavy expenditure are frequently under consideration. It appears to me that the time has arrived when sanitarians in India might reasonably expect to be furnished with more reliable and accurate statistics on which to base their recommendations, and by accurate statistics I mean not only accurate as to totals, but also at least approximately true as to other details such as date, age, sex, place, cause, &c. Such returns are the true basis of all recommendations and action in sanitary matters and without them such recommendations have to be made, and action to be taken, more or less in the dark. What the compass is to the navigator, statistics are to the sanitary officer. A skilled seaman may bring his ship safe to harbour guided only by experience and the sanitary officer, by a careful use of general principles, may avoid the many pitfalls in his path, but in either case it is largely a matter of luck. Further, correct and full vital statistics are the only gauge by which we can measure the good which has been done and without them it is impossible to give a satisfactory and convincing reply to the criticism one now often hears that the money spent on sanitary improvements has given no tangible return. It may be suggested that dispensary registers would give us all the information required. These are no doubt useful and throw considerable light on the prevalence of particular diseases and causes of mortality, but there are many diseases (phthisis is a prominent example) which may be common and yet, for various reasons, the hospital registers give no indication of their presence. In my own provinces all Civil Surgeons and all medical subordinates send to me returns of the deaths occurring within the limits of their practices and independent medical practitioners have been encouraged to do the same. These returns too are useful as a general guide, especially as to the age distribution of particular diseases, but they fall very far short of being a complete key to what we require, *viz.*, the causes of mortality in particular places.

The whole matter seems to me of the very first importance and I would put forward the following scheme for the registration of vital statistics in municipalities for discussion :—

- (1) That all heads of families and all superintendents or managers of public institutions be required to report births and deaths occurring within their respective jurisdictions within three days subject to a penalty of fine not exceeding Rs.10.
- (2) That, as a check on this reporting, all sweepers be required to report similarly subject to a penalty of Rs.2, but also that a reward of one pice be given for each correct report made by them.
- (3) That all reports be made to, and the actual registration be done by, one or more *medical* registrars of the grade of Sub-Assistant Surgeon specially appointed by the municipality for this duty and for the verification of the reports *only*.
- (4) That the Health Officer should be the registrar of vital statistics for the municipality and be responsible for the supervision and checking of all registration.

This scheme is not altogether a new one but is rather only an extension and amplification, to obtain greater accuracy, of the system at present in vogue. The expenses would not be great. A population of 25,000 would give on an average 150 reports each month so that one Sub-Assistant Surgeon should be able easily to overtake the work in a town of that number of inhabitants. Government are yearly granting large sums for the improvement of sanitation in the municipalities, and it seems to me that part of this money might be most usefully earmarked for grants-in-aid to such towns as are willing to appoint the necessary staff.

My contention is, gentlemen, that with such large interests at stake we should trust nothing to chance but should seek round for every help to guide us that is possible. We are not dealing with a highly developed science but with one which, as applied to India, is still in its infancy and requires investigation and enquiry at every step. The groundwork to all such enquiries is a full and complete birth and death return.

(Signed) J. C. ROBERTSON, *Major, I.M.S.*

APPENDIX 14 to No. 4.

NECESSITY FOR AN UNIFORM METHOD OF WATER ANALYSIS IN INDIA AND A UNIFORM NOMENCLATURE OF FÆCAL ORGANISMS.

In a meeting constituted such as this it is obviously unnecessary for me to discuss at any great length the necessity of an uniform method of water analysis and an uniform nomenclature of fæcal organisms found in water. It may, however, just be pointed out that the following are the main advantages that would accrue from the above proposal :—

- (1) With the amount of routine work that one has to perform only a limited amount of research work can be done, consequently it would take many years for any single institution to really investigate the natural conditions of drinking water in this country. It is obvious that if all the laboratories work on the same lines this can be totalled up and progress will be much more rapid.
- (2) That the results of research and routine work will be comparable the one with the other whether the water be taken in from the Punjab or Madras provided the method of examining the sample is similar in both instances. On the other hand supposing each laboratory in India where water examination is carried out, use a different method and different series of media, &c., it is perfectly obvious that results which are valuable in themselves will not be able to be compared with those of other parts of the country and there will be an enormous waste of scientific energy in consequence. I therefore beg to lay before this meeting the following as being the most suitable method for examining water in all the laboratories in this country :—

- (a) The total number of colonies that are visible to the naked eye grown on the neutral agar (+10 to normal carb. solution) incubated at a temperature of 37 for a period of 2 days. This record has undoubtedly certain uses though its utility is very variable in different parts of India, for instance the Hughli water contains a very large number of spore-bearing organisms which covers the whole of the plate and renders counting quite impossible. On the whole I consider it should be continued as it may give valuable information.
- (b) Water should then be put into bile salt neutral red lactose broth tube in the following quantities: 1·20 c.c., 2·10 c.c., 3·5 c.c., 3·1 c.c., 3·1 c.c., 3·01 c.c. This is after all only the usual method. We consider that in order to save medium 3 tubes for each quantity give fairly satisfactory results. If acid and gas be present in 2 out of 3 of any given series, it is recorded that the fæcal organisms are present in that quantity of the original sample.

2. In this step several points are open for discussion. By far the most important of this is, shall we use a lactose or a glucose broth? From a very large amount of research work (which will shortly be published) it is found that there are advantages in both, but as there is a limit to the amount of work that can be carried out we recommend a lactose broth. There is no doubt whatever that for samples where a very thorough knowledge of the conditions of water at any given time is required both glucose and a lactose broth should be used and the difference between the two compared, but this is both a long and a somewhat troublesome piece of work. Therefore for routine methods lactose broth only should be used for the following reason :—

By far the majority (96 per cent.) of all organisms in fresh fæces, that flourish in bile salt media, ferment lactose; the true intestinal organism is a lactose fermenter. There are varieties which do not ferment lactose but these are not numerous in fæces; in water analysis it is better if possible to form an opinion as to the condition of pollution by a study of the common organism rather than rare ones. A further discussion by this most interesting point will, as I have already mentioned, be published shortly. All bile salt broth tubes should be incubated at 42°C. for 48 hours before the results are recorded.

3. The next step is to make a study of the organisms which have grown in the bile salt lactose

broth. In order to do this these bacilli have to be planted out on a solid medium and I recommend bile salt neutral red lactose. The originator of this as a solid medium was Dr. MacConkey. From many years' experience it has been found to have no equal as a solid medium for the ordinary intestinal organisms. The technique of making plates need not be described to this meeting. The organisms for plating out should be taken from a 20 c.c. tube, otherwise the natural mixture is not obtained; 18 hours' incubation is usually sufficient; it is important not to wait longer as the increasing acidity may kill off some bacilli and so alter the picture of the flora in the water.

4. Having got plates with isolated colonies, we now approach the difficult point as to what is the best method of taking the process further and it is this step which is really open to so much difference of opinion. There are two important methods which are largely followed by water analysts all over the world. Dr. Houston is the great exponent of the first of these. Having obtained isolated colonies in the way described each is tested to ascertain (1) whether it ferments lactose, (2) whether it ferments saccharose, (3) whether they give the indol reaction. If it gives lactose + saccharose — indol + he calls it "true coli." If a colony give lactose — or saccharose + or indol — or any combination of these he calls it an "atypical coli."

5. The second method and by far the most useful one is the one recommended by MacConkey. He passes each colony through the following carbohydrates:—

Saccharose Dulcitol Adonitol Inulin, Voges and Proskauers reaction, Indol reaction, and examines them for Motility. By this method, which sounds very much more complicated than it really is, it is possible to separate the important species of all intestinal organisms that will grow in a bile sort media. A reference to the table further on will give the number of faeces already isolated.

These are the two important methods; let us first of all consider the advantages and disadvantages of Houston's method. The advantage that may be claimed for it is that it is short and simple. This is about all that can be said for it. The disadvantages are of a scientific nature: (1) it makes use of the terms "true coli" and "atypical coli" both of which terms are unhappy, for they do not convey the same meaning to all scientists and no two water analysts agree as to the significance of these groups. Secondly, the term "true coli" includes many different species, for by the use of MacConkey's method it can be demonstrated that these are entirely different organisms, such as *Bacillus acidilactici*, *mutabilis*, and others which give all the tests of Houston's true coli. It is therefore obviously objectionable to call 10 or a dozen entirely different organisms by one name. A very important fact frequently lost sight of by bacteriologists is that the laboratory reactions of one organism do not give any indications whatever of the conditions under which they live in nature or resist inimical influences. Supposing all the letters of the alphabet represent different organisms found in faeces, and assuming A, D and Q are found by experiment and by study of nature to be very delicate and to disappear rapidly from water, it is obviously advisable to find out whether a sample contains any of these varieties. On the other hand if B and G are very resistant and live for weeks in water it is obviously necessary to look for these varieties because of the conclusions that can be drawn from their presence. Obviously therefore we must separate species; ill-defined groups such as "true coli" and "atypical coli" are not satisfactory. A study of the natural characteristic of these various organisms is of course a long and tedious business and will take years before anything like finality can be arrived at, but my point is this:—If by the use of MacConkey's method we find out what organisms are present in a sample, so there is some hope that a conclusion may be drawn concerning the pollution. If on the other hand we simply are content with the fact that intestinal organisms exist in the water it means that practically every sample of water in India will be condemned. From a very great deal of experience now extending over four years (the results of which are shortly to be published) there can be no doubt whatever that by finding out what organisms are present in a sample, it is possible in India to make a very fair guess at a time when the pollution was added. Consequently MacConkey's method is vastly superior to all others. I recommend that 10 colonies from each sample be put through these various tests. At the end of this paper will be found the quantities required for the making of the various media. The indol reaction should be done with paradimethylamido benzene, the tubes being incubated four days at least.

6. It may be contended that this method is too elaborate for routine. As a matter of fact I disagree entirely with this contention, because if water is worth analysing at all you must find out all you can about it in order to give an opinion, but I admit that in some cases this elaborate method does give more information than is necessary. Therefore as an alternative or short method I suggest the following, *viz.*, that the colonies growing on the bile salt neutral red lactose agar be put through the two broth tests only, namely, saccharose and dulcitol; this will divide the organism into MacConkey's four classes which are:—

- Class I—saccharose — dulcitol —
- Class II—saccharose — dulcitol +
- Class III—saccharose + dulcitol +
- Class IV—saccharose + dulcitol —

The method of interpreting the results obtained is based on one fact, *viz.*, that practically all organisms in class II should be looked upon with very grave suspicion. Most, though not by any means all, of these belong to the varieties which are very susceptible to the action of sunlight. This rule does not by any means hold good entirely, because there are one or two varieties in classes III and IV which are also probably very delicate organisms. In making use of this abbreviated method great attention should be paid to the number of faecal organisms present that grow in lactose broth. It is the *amount* of lactose fermenting pollution which will really give the main indication as to whether the water is pure or highly polluted; but it is advisable also to find out whether organisms which are saccharose — dulcitol + are present as well. If in any sample lactose fermenters are present in .1 or .01 of c.c. and amongst these organisms certain which are saccharose — dulcitol + are common it is quite sure that the pollution is of a dangerous character.

It must be understood that I disapprove of classifying organisms according to their fermentative reaction. The only sound classification from the point of view of water analysis is whether an organism is susceptible or resistant to natural influences.

As regards the nomenclature of organism we have found that suggested by MacConkey is the best for all practical purposes. I herewith append the table and I recommend that bacilli isolated from water be named and numbered in the way described by this author.

TABLE I.

Number.		Lactose.	Saccharose.	Dulcit.	Adonit.	Inulin.	P. and V. reaction.	Indol.	Motility.	Gram stain.	Gelatin.	Litmus milk.	Acidity in litmus whey.	Reduction of nitrates.	Inosit.
1	...	+	-	-	+	-	-	+	+	-	-	+	Per cent.	+	-
2	B. Acidi lactici (Huppe)	+	-	-	+	-	-	+	+	-	-	+	23	+	-
3	B. Levans	+	-	-	-	+	+	-	+	-	+	+	14	+	-
4	B. Grunthal	-	+	-	-	-	-	+	+	-	-	+	20	+	-
...	B. Sulcatus gasiformans	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	B. Castellus	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	B. Vesiculosus...	+	-	-	-	-	-	+	+	-	-	+	25	+	-
6	...	+	-	-	-	-	-	+	+	-	-	+	...	...	...
7	...	+	-	-	-	-	-	+	+	-	-	+	...	...	...
8	B. Coli mutabilis (Massini)	+	-	-	-	-	-	-	+	-	-	+	...	...	...
*9	...	+	-	-	+	-	+	+	-	-	-	+	...	...	...
*10	...	+	-	-	+	-	-	+	+	-	-	+	...	...	...
33	...	+	-	+	+	-	-	+	+	+	-	+	...	...	...
34	B. Coli communis	+	-	+	-	-	-	+	+	-	-	+	28	+	-
...	B. Cavicidae	+	-	...	...	...	...	...	...	...	...	...	...	...	...
35	B. Schaefferi	+	-	+	...	...	...	+	...	...	...	+	22	+	...
36	...	+	-	+	+	-	-	-	+	-	+	+	...	+	-
*37	...	+	-	+	+	-	-	+	...	...	...	...	...	...	...
*38	...	+	-	+	+	-	-	...	...	...	...	...	...	...	...
*39	...	+	-	+	+	-	-	...	...	...	...	...	...	...	...
65	B. Oxytocus perniciosus	+	+	+	+	+	+	+	+	-	+	+	26	+	+
66	...	+	+	+	+	+	+	+	-	-	-	+	...	+	+
67	...	+	+	+	+	-	+	-	-	-	-	+	...	+	+
68	B. Rhinoscleroma Pneumoniae	+	+	+	+	-	-	-	-	-	-	+	14	+	+
69	...	+	+	+	-	+	+	-	+	-	+	+	...	...	...
70	...	+	+	+	-	+	-	+	+	-	+	+	...	...	...
71	...	+	+	+	-	-	-	+	+	-	-	+	...	...	...
72	B. Neapolitanus	+	+	+	-	-	-	+	+	-	-	+	22	+	...
73	...	+	+	+	-	-	+	-	+	-	+	+	...	+	...
74	...	+	+	+	-	-	-	-	+	-	-	+	...	...	...
75	...	+	+	+	-	-	+	-	-	-	-	+	...	...	...
97	...	+	+	+	+	+	+	+	-	-	+	+	...	+	+
98	...	+	+	-	+	+	+	+	-	-	-	+	...	+	+
99	...	+	+	-	+	+	-	-	-	-	-	+	...	+	+
100	...	+	+	-	+	-	-	+	+	-	-	+	...	+	+
101	...	+	+	-	+	-	-	+	+	-	-	+	...	+	+
102	...	+	+	-	+	-	+	-	+	-	+	+	...	...	...
103	B. Lactis aerogenes	+	+	-	+	-	+	-	+	-	+	+	30	+	+
...	B. Dysenteriae Vitulorum	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	B. Capsulatus (Pfeiffer)	...	...	...	...	...	...	...	...	...	...	...	...	...	...
104	B. Gasiformansnon-liquefaciens	+	+	-	+	...	+	...	...	...	...	+	12	+	...
105	...	+	+	-	-	+	+	-	+	-	+	+	...	...	...
106	...	+	+	-	-	-	-	+	+	-	-	+	...	...	...
107	B. Coscoroba	+	+	-	-	-	-	+	-	-	-	+	25	+	-
108	B. Cloacae	+	+	-	-	-	+	-	+	-	+	+	20	+	-
109	...	+	+	-	-	-	-	-	+	-	-	+	...	...	...
*110	...	+	+	-	-	+	-	-	...	...	...	...	...	...	...

I also recommend that the term "coli," "true coli" and "atypical coli" be entirely given up in reporting on the samples of water. If any class of intestinal organisms are indicated they should be described as lactose fermenter or glucose fermenter as the case may be, thus :—

Reports should read "lactose fermenting organisms present in 5 c.c." instead of "coli in 5 c.c."

The term Coli Communis being reserved for Escherichs organism which gives the following reactions :—

Saccharose —, dulcit+, adonit—, inulin—, Vosges and Proskauers reaction—, Indol+, Motility+.

List of Media used in the work.

- I. (Stock solution A).—Bile salt glucose peptone neutral red broth—
- | | | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|----------------------------------|
| Peptone | ... | ... | ... | ... | ... | ... | 60 grms. |
| Sodium taurocholate | ... | ... | ... | ... | ... | ... | 15 " |
| Glucose | ... | ... | ... | ... | ... | ... | 15 " |
| Water | ... | ... | ... | ... | ... | ... | 1 litre. |
| Neutral red | ... | ... | ... | ... | ... | ... | 10 c.c. of 5 per cent. solution. |
- Normal sodium Carbonate solution ... } Till neutralised as indicated by the natural red.
- (B Solution)—
2 parts of A solution+1 part of water.
- (C Solution)—
1 part of A solution+ 1 part of water.
- (D Solution)—
1 part of A solution+ 2 parts of water.

II. Bile salts lactose, peptone neutral red broth—									
Same as above, lactose being substituted for glucose.									
III. Bile salt lactose peptone agar—									
Peptone	...	...	...	...	...	...	...	...	20 grms.
Sodium taurocholate	...	...	...	...	...	...	...	...	5 "
Lactose	...	...	...	...	...	...	...	...	10 "
Agar	...	...	...	...	...	...	...	...	20 "
Water	...	...	...	...	...	...	...	...	1 litre.
Neutral red	...	...	...	...	...	...	...	...	10 c.c. of 5 per cent. solution.
Normal sodium	...	...	...	...	...	...	...	...	} Till neutral point is reached as indicated by the neutral red.
Carbonate solution	...	...	...	...	...	...	...	...	
IV. Nutrient agar—									
Agar	...	...	...	...	...	...	...	...	20 grms.
Lemco	...	...	...	...	...	...	...	...	5 "
Peptone	...	...	...	...	...	...	...	...	10 "
Sodium chloride	...	...	...	...	...	...	...	...	5 "
Water	...	...	...	...	...	...	...	...	1 litre.
Standardised to +10 using normal solution of sodium carbonate.									
V. Nutrient broth—									
Peptone	...	...	...	...	...	...	...	...	10 grms.
Sodium chloride	...	...	...	...	...	...	...	...	5 "
Lemco	...	...	...	...	...	...	...	...	5 "
Water	...	...	...	...	...	...	...	...	1 litre.
Standardised to +10 using normal solution of sodium carbonate.									
VI. Bile salt peptone neutral red sugar medium—									
Peptone	...	...	...	...	...	...	...	...	10 grms.
Bile salt	...	...	...	...	...	...	...	...	5 "
Sugar	...	...	...	...	...	...	...	...	5 "
Water	...	...	...	...	...	...	...	...	1 litre.
Neutral red	...	...	...	...	...	...	...	...	5 c.c. of 5 per cent. solution.

To prepare different sugars, the particular sugar is substituted in the column of sugar in the above solution.

The following sugar media are made :—

- | | |
|----------------|-------------|
| 1. Saccharose. | 3. Adonite. |
| 2. Dulcite. | 4. Inulin. |

VII. Glucose medium for Vosges and Prosk. reaction—

Peptone	...	...	...	...	...	...	...	...	10 grms.
Glucose	...	...	...	...	...	...	...	...	5 "
Water	...	...	...	...	...	...	...	...	1 litre.

VIII. Strong peptone solution for vibrios—

Peptone	...	...	...	...	...	...	...	...	100 grms.
Sodium chloride	...	...	...	...	...	...	...	...	50 "
Water	...	...	...	...	...	...	...	...	850 "

10 c.c. of this in 90 c.c. of suspected water converts latter into 1 per cent. peptone water.

(Signed) W. W. CLEMESHA, M.D., D.P.H., Major, I.M.S.

APPENDIX 15 to No. 4.

INFANTILE MORTALITY.

With Captain Graham I have investigated the causes of death in the case of 661 children dying under one year of age in four different towns, and as the results we obtained are somewhat different to those generally shown, I thought it might be of some slight interest to give a short note on the subject without entering into very great detail. The causes of the mortality were as follows :—

Malaria	...	...	...	...	...	149	(A large majority of these were indirectly due to malaria, though some had their causes in other diseases.
Diarrhoea and dysentery	...	...	...	...	...	108	
Bronchitis and pneumonia	...	...	...	...	...	87	
"Born weakly," premature birth and inanition	...	...	...	...	...	214	
"Other causes"	...	...	...	...	...	43	(including 14 due to tetanus).
Plague	...	...	...	...	...	21	
Not diagnosed	...	...	...	...	...	39	
Total	...	...	...	...	...	661	

As a single direct cause of death malaria was by far the most important giving 149 or 22.5 per cent. of the total. This was probably due, to a certain extent, to the fact that the enquiry was made in towns which had rather a bad reputation for that disease but, even making due allowance for this fact, malaria would appear one of the chief direct causes of infantile mortality. If the 214 deaths under "born weakly," premature birth, and inanition are taken as for the most part caused by it as well, it was indirectly responsible for a very large proportion of the mortality indeed.

"Diarrhoea and dysentery," with 108 deaths or 16·3 per cent. of the total, came as the next chief cause. These were generally to be attributed to insanitary surroundings—filth-soaked soil due to defective conservancy and the insanitary habits of the people.

Bronchitis and pneumonia, with 87 deaths or 13·1 per cent. of the total mortality came as a close third. Most of these were cases of very ordinary colds which, with a little care, should have quickly cleared up and done no harm but which, being neglected, gradually developed to a fatal issue from broncho-pneumonia.

Of the "other causes" tetanus was the most important and caused 14 deaths or 2·1 per cent. of the total mortality. I know this is not the usual position given to this disease as a cause of infantile mortality, but we made most careful enquiries and I feel convinced that its influence, in the present series of cases at any rate, was not under-estimated. Many children develop convulsions in the course of other diseases shortly before death and these I feel sure have very frequently been mistaken for tetanus by the parents and their diagnosis been too readily accepted as accurate.

I would classify the causes of infantile mortality in the four towns examined, in their order of importance, as follows :—

- (1) Malaria—operating both directly on the infant and indirectly through the mother,
- (2) Diseases due to insanitary surroundings,
- (3) Diseases due to ignorance on the part of the mother with regard to the feeding and care of the infant, and
- (4) Accidents and diseases due to childbirth.

(Signed) J. C. ROBERTSON, Major, I.M.S.

APPENDIX 16 to No. 4.

RECENT RESEARCHES IN CONNECTION WITH PLAGUE IN INDIA.

A review of the work of the Plague Commission during the year 1910-1911 by Major W. Glen Liston, M.D., D.P.H., I.M.S., Senior Member, and Captains Gloster, Kunhardt, White, and Taylor, with their assistants.

PART I.

Under the first head we will consider :—

- (a) Observations on the habits and breeding of the Indian house rat *Mus rattus*.
- (b) Observations on the development and multiplication of the Indian rat flea *Xenopsylla cheopis*.
- (c) Observations on natural immunity to plague in *Mus rattus*.
- (d) Observations on chronic or resolving plague in wild rats.

(a) Observations on the Habits and Breeding of *Mus rattus*.

Most of the work which has been done in the past on this subject has referred to the rat known as *Mus decumanus*. Our experiments have been made with *Mus rattus*, the common house rat of India. Attempts to breed wild rats in captivity have generally been unsuccessful. After many failures we at last succeeded in breeding and observing wild rats in captivity in specially constructed godowns, which we shall be glad to show to any members of this Conference. These godowns afford shelter to the rats in artificial burrows and nests which can be opened easily for purposes of inspection. Preliminary experiments in these godowns revealed the fact that rats would not breed when overcrowded. These first experiments were made with one, two, four, eight, and sixteen pairs of rats in each godown. They covered a period of over two months, but, save only in the godowns in which a single pair of rats was confined, no young were produced. It was interesting to note that, in the godowns with four or more pairs, an examination of the females after they had been killed showed that no one of them was pregnant. This excluded the possibility that young rats had been born and had been eaten before they were seen by us. It also showed that when overcrowded the rats do not breed.

Our further experiments were carried out generally with single pairs of rats, and a large number of young rats were bred. Some of these young rats were used in certain immunity experiments to be referred to later, others were used to breed second and third generations of rats. The number of young produced by a series of single pairs is of interest. One pair produced thirty-four young ones in nine months and twenty-six days with an average of about five young per litter. Another pair produced in seven litters forty-three young in thirteen months and twenty days. A third pair in three litters produced seventeen young in four months and thirteen days. A fourth pair had twenty-nine young in seven litters during eleven months and ten days. A fifth pair had thirty-three young in five litters in eleven months and twenty-two days.

These figures give an average of thirty-six young per pair in one year or a litter of six (the most frequent number) every two months. In sixteen observations the average interval between any two litters was approximately fifty-three days.

A pair of rats bred in the godowns gave a litter when the male was four and the female five and half months old. Rats, however, look fully grown by the end of the third month, and in nature may breed at this age. The period of gestation we found was between three and four weeks. We observed that a few more females than males were born in captivity. Of fifty-five young rats born in the godowns and noted for this purpose, 24 or 43·6 per cent. were males and 31 or 56·4 per cent. females. Compare these figures with rats caught in Bombay. In 30,000 observations, 51 per cent. were males and 49 per cent. females.

The young rats born in captivity were frequently eaten by their parents. Ten out of thirty-five litters were so destroyed. Six of these ten were eaten by the female alone, while four others were eaten either by the male or the female. The extent to which this destruction goes on under wild conditions is probably an important factor in keeping rat infestation at a comparatively constant level. It is possible, however, that in our godowns more young rats were destroyed in this way than

actually occurs in nature, for our young rats were much handled to make measurements and obtain weights at different ages as we shall relate presently. Nevertheless some litters were eaten before they were handled.

With these data we are in a position to gauge approximately the reproductive powers of rats. A single pair produce say six rats every two months; these young rats in turn are able to produce young ones in approximately four months. Males and females are produced in about equal numbers. On an average say one litter of every three produced is destroyed by the parents before the young reach maturity. In these circumstances in less than one year a single pair may have multiplied to fifty pairs. If this rate of multiplication were continued for a year and a quarter the number of rats would be very great indeed. As a matter of fact observations in the field show that such rapid multiplication does not actually take place; it is probable that overcrowding, destruction by natural enemies, and disease keep down the numbers. There is another very important factor which has to be taken into consideration in making such calculations. It should be remembered that not every pair of rats is at all times equally fertile. The number of rats we experimented with was too small to yield any reliable estimate on this score, but by a somewhat complicated calculation we reckon that nearly one pair in every four may be considered to be relatively infertile in the sense that reproduction with them does not go on at the estimated rate of a litter every two months. Even making this allowance but taking no account of the effect of disease and destruction by enemies, it does not seem possible to give a lower estimate than that a single pair of rats may multiply to forty pairs in the course of a year.

Experience in the field, as will be shown later, does not by any means confirm this estimate. Difficulties are met with in the field that prevent us making an accurate estimate of the rat infestation of any place; but the field experience is sufficient to put us on our guard in calculating the reproductive power of rats solely from laboratory observations. Nevertheless these experiments have convinced us that rats can multiply very rapidly, and the important deduction can be drawn from them that any destructive measures against rats must be very thorough and very persistent.

Some observations have been made on the rate of growth of young rats. The weight of a young rat at birth is about four grammes. The average weight of each young one in seven litters was noted at 4.3 grammes. The rate of increase of weight was approximately one gramme per diem for the first three months. Thus, according to our observations, the weight of a rat in grammes, minus four grammes, the weight at birth, gives a figure approximating to its age in days.

At birth the tail of the young *M. rattus* is only about half the length of the head and body together, but it grows rapidly and is equal in length to the head and body a fortnight after birth. At the end of the first month the tail has attained its proper length in proportion to the head and body.

(b) *The Development and Multiplication of the Rat Flea Xenopsylla cheopis.*

It would take too long to detail the many and prolonged series of experiments that have been carried out, but we may state that it has been found that, with certain limits of temperature, the humidity of the atmosphere materially affects the life and development of the rat flea. To begin with it has been found that during the dry season in Poona, January to April, ninety-five fleas kept in dry test tubes plugged with cotton wool and covered with rubber caps laid 145 eggs or 1.5 eggs per flea, while in a similar series of tests, save only that a drop of water had been placed in the plugs before the tubes were capped, forty-five fleas laid 110 eggs or 2.4 eggs per flea, an increase of sixty per cent. in the moister atmosphere. Humidity thus favours the laying of eggs and succeeding experiments show that it has even a greater influence on their hatching.

The eggs laid by the fleas were transferred to three series of test-tubes, each containing a little bran. In the first series the tubes were plugged with cotton wool and covered with air-tight rubber caps so that in them the atmospheric moisture at the beginning of the experiment remained constant throughout. In another series an artificially moist atmosphere was created by placing a drop of water on the cotton wool plug, while in a third series the air was dried by placing in the tubes a small drying disc (asbestos saturated with calcium chloride).

Of 150 eggs placed in the untreated tubes forty-three or twenty-eight per cent. developed into larvæ. One hundred and fifty-one eggs in the moist air tubes yielded sixty-six larvæ or nearly forty-four per cent., and of twenty-eight eggs in the dry air tubes not one developed.

Humidity has also a marked influence on the lives of flea larvæ. It was found that, during the dry weather months in Poona, January to March, not a single larva out of 316 lived to become a pupa, while in an artificially moist atmosphere 13 out of 276 larvæ reached the pupal stage and all ultimately emerged as fleas.

That atmospheric humidity has further a marked influence on the life of the adult flea or imago will be seen in the following experiment. Three series of test-tubes were taken similar to those described above, and in each test-tube were placed five fleas. The fleas were not fed on blood so that they gradually died but the number alive each day was noted. Each flea alive at the end of the first day received one mark, each alive at the end of the second day received two marks, each alive at the end of the third day three marks, and so on till all were dead. The marks thus obtained were totalled and then divided by five, the number of fleas used in each test-tube; a figure was thus obtained which, for want of a better name, we have called the aggregate average life of five fleas in days.

The experiments were carried out in Poona from January to April. In the untreated tubes forty-five fleas gave a mean figure of 18, and thirty fleas in the dry air tubes gave a mean figure of 5.1. It will thus be seen, at the temperature of Poona during the months January to April, a humid atmosphere favours the laying of eggs by fleas; more eggs hatch into larvæ, more larvæ develop into pupæ and the life of the fully developed flea is likewise prolonged.

It remains only to add that when humidity is in excess (over 80 per cent.) and the temperature high (over 85° F.) moulds develop in the media on which the flea-larvæ feed, and these apparently kill the larvæ so that few reach maturity.

This laboratory experience is in accord with our observations in the field. The number of fleas found on rats during the hot and dry season is very much less than during the cold and relatively

humid period of the year; and we may draw the conclusion that, on the whole, a relatively humid cold weather is likely to be associated with a severer epidemic of plague because the flea prevalence under such circumstances is likely to be high. There are, however, other factors which influence the prevalence of plague in any place, and these may cause us to modify this conclusion. Such factors are a scarcity of rats, which may occur after a recent epidemic, or an immunity to plague among the rat population, and this, we will see, is gradually brought about after a series of epidemics.

(c) *Observations on Natural Immunity to Plague in Mus rattus.*

We will now consider some observations on natural immunity to plague among *M. rattus*.

Perhaps no more important observation during the whole work of the Commission has been made than that in the course of a series of epidemics of plague there is evolved a race of rats which is naturally immune to the disease. This is a comforting discovery, for it assures us that in process of time, it may be after very many years, plague will disappear from India, as it has done in the past ages. One of us once made certain suggestions for the prevention of plague and an influential opponent of the proposed measures concluded his remarks by saying, "if you can tell us how plague disappeared from India in past ages, in spite of the fact that then there were no modern methods of sanitation to account for its disappearance, we will believe that you know something as to how plague is spread." At the time an entirely satisfactory reply to this challenge could not be given. But now we seem to have found the explanation and it is that, following the introduction of plague, a race of rats, which is comparatively immune to the disease, is established gradually by a natural process of selection and the survival of the fittest.

Thus, using for experimental inoculation a minute dose of plague virus, say twelve to twenty-four thousand virulent plague bacilli, which is equivalent to about one hundred thousandth part of a grain of an infected rat's spleen, we at present find that ninety-seven to one hundred of every hundred rats from Madras City die after infection and that only some twenty out of every hundred rats from Bombay City will succumb. Not only so but, repeating the experiment with large numbers of rats, we find that plague-free towns such as Madura, Raipur and Dacca yield rats which give a 90 to 100 per cent. mortality from plague and that plague-stricken places like Cawnpore, Lucknow, Poona and Bhagalpur yield rats highly immune to the disease and giving a mortality of only 20 to 40 per cent. Moreover the immunity of the rats in each of these places is in proportion to the number and severity of the epidemics from which each town has suffered. Cawnpore shows the greatest immunity with a mortality between 12 and 20 per cent. Poona and Bombay come next with a mortality between 16 and 25 per cent. Lucknow and Bhagalpur follow with 30 and 40 per cent. respectively.

That the immunity to plague is transmitted from parents to offspring, and is not acquired, is indicated by the fact that young rats from Bombay and young rats from Poona, caught at an age and at a time when they could not have been exposed to infection, are only very slightly more susceptible to plague than the adult rats of the same places.

This view of the hereditary transmission of natural immunity has been confirmed by two series of godown experiments in which rats bred in the godowns from known stock were used.

In the first series ordinary wild Bombay rats were allowed to breed and their progeny, when a sufficient number had been collected, were inoculated and compared with a similar series of wild Bombay rats. The mortality among the wild rats was 21 per cent. while that among fifty godown-bred rats, treated with the same dose, was 20 per cent.

In the second series, rats bred from the survivors of experimentally produced epizootics in the godowns were used. Their parents had all been exposed to most severe infections and were therefore probably highly immune. That their young were extraordinarily resistant to plague was proved by only one out of twenty-five or 4 per cent. succumbing to a dose of virus sufficient to kill 19 per cent. Cawnpore rats, 21 per cent. Bombay and Poona rats, 32 per cent. Lucknow rats, and 99 per cent of those from Madras.

We have, we believe, in these experiments good evidence to show that in time plague will of itself die out of India. It may be long hence, and will in all probability be very long, unless rational measures are taken to fight the disease.

(d) *Observations on Chronic or Resolving Plague in Rats.*

Only briefly do we wish to refer to our work on Chronic or Resolving Plague. We are more convinced than ever that a large number of rats recover from the disease; this is especially the case in places which have suffered from repeated epidemics. Moreover, we have been able to produce chronic plague in many of the thousands of rats we have inoculated in connection with the immunity experiments referred to above. The lesions found in these rats correspond exactly in character to those which we have found in naturally infected rats, but which for one reason or another we were unable to prove were plague lesions. In the light of further experience of plague in rats we have amended our classification of plague lesions into acute, sub-acute, resolving or chronic, and recovered plague lesions and we can reaffirm, after more extended observation, the opinion expressed in our reports that we have no reason to think that chronic plague lesions play any part in the annual recrudescence of plague.

PART II.

We will pass on to review our recent work in the field and in this connection we will consider:—

- (a) The work in Eastern Bengal and Assam.
- (b) The work in Poona City.
- (c) The work in the United Provinces.
- (d) The work in the Madras Presidency.

(a) *The Work in Eastern Bengal and Assam.*

Our work in Eastern Bengal and Assam was brought to a close towards the end of last year. The problem we had set ourselves to solve may be stated thus. From the time that plague first appeared

in India in 1896 to the present date only two very limited epidemics of the bubonic type of the disease have been reported in the Province of Eastern Bengal and Assam.

One of these epidemics occurred in 1903 in the town of Dibrugarh in the extreme North-East of the Province. During this epidemic there were thirty-six cases and twenty-eight deaths and it was localised to certain grain godowns and their immediate neighbourhood. Evidence of a co-existing epizootic was furnished by the finding of dead rats. The second epidemic of bubonic plague was of a more doubtful nature. Eight cases with seven deaths were reported in 1907 in a small hamlet in the Manipur district in the extreme east of the province. No evidence of rat mortality was obtained on this occasion and the true nature of the outbreak was never definitely determined.

Apart from these two epidemics a small number of imported cases of bubonic plague have been recorded on a number of occasions in different towns and villages. While this has been the experience of the Province as far as the bubonic type of the disease is concerned, it has been different in respect to the pneumonic. Cases of pneumonic plague were known to have been imported into the Province on at least nine separate occasions. On each occasion the imported case has been associated with cases of local origin and epidemics of pneumonic plague, more or less severe, have developed in connection with these imported cases.

When we remember that only about 3 per cent. of the cases of plague in India are of the pneumonic type, that no very elaborate precautions are taken to register all cases of plague in the Province and that communication with infected areas is freely allowed, we are forced to the conclusion that many cases of bubonic plague must be imported into the Province, but are not registered and that pneumonic cases come to notice mainly because they are associated with epidemics of the disease.

Having established the fact that communication with infected places was maintained to some extent and that the nearest plague-infected places, apart from Calcutta City, were found in Behar, it was necessary to enquire why epidemics of bubonic plague were so rare in Eastern Bengal and Assam, while the disease flourished in parts of the adjoining districts of Behar. With this object in view, an examination of rats and fleas was made in certain selected places in Dacca town, Chittagong and Jaktabari in Eastern Bengal and in Bhagalpur and Purneah in Behar. The last place was selected because it was itself free from the disease, and is situated between plague-smitten Bhagalpur and the Province of Eastern Bengal and Assam. Observations in these places showed that while fleas were fairly numerous upon the rats (at one time in the month of April numbering nearly nine per rat in Dacca City), the number of rats caught in the towns of Eastern Bengal and Assam and in Purneah in Behar were very few in comparison with the number caught in plague-stricken Bhagalpur, where, too, the fleas on the rats were numerous.

Thus, in all the above-mentioned places, save only in Bhagalpur, the number of rats caught per 100 traps set was under ten, whereas, in Bhagalpur, thirty-four rats were caught in every hundred traps set. The greater rat infestation of Bhagalpur, as compared with the towns of Eastern Bengal and Assam, is accounted for by the structure of the houses and the habits of the people. While in the former place the houses resemble those found in Poona and Belgaum being built closely together, constructed for the most part of mud, roofed with country tiles, and frequently strewn with rubbish; those in the latter places are generally scattered and are either solidly constructed with cement plinths and with roofs of stone slabs, or they are more of a flimsy build with walls of bamboo matting and roofs of corrugated iron or thatch, affording little shelter for rats. Moreover, the houses are kept in good repair, and the heaps of litter and rubbish, so commonly seen in Bhagalpur and Poona, are more rarely met with in the towns and villages of Eastern Bengal.

We believe, from those observations, that the habits of the people and the structure of their houses have much to do with the presence or absence of plague in their midst.

(b) *Observations in Poona.*

We have now carried on work at Poona continuously for three years. During two of these years, the city has been practically free from indigenous plague, so that, on rats and fleas, we have made observations which have not been interfered with by the presence of an epizootic. During the first year we were able to follow the course of an epidemic. In the two following years we studied what may be regarded as the normal conditions, and now we are at the commencement of another epidemic. The observations during these three years are of much interest, but we can only briefly refer to the more important.

At the close of the first epidemic, we found that the number of rats per 100 traps set was as low as nineteen. The number of rats caught thereafter steadily increased from this figure to something over sixty rats per 100 traps set—the figures at the commencement of the present epidemic—although during this period we caught and destroyed more than seventy-two thousand rats, or from two to three thousand rats every month.

This increase in the rat population, though not so great as might have been expected from the calculations made from the figures obtained in our breeding experiments in the laboratory, is yet sufficiently imposing to convince us that the decrease of the rat population of any place will be accomplished more satisfactorily, if more slowly, not by waging a direct war upon the rodents, but by improving the structure of buildings, especially grain godowns, and such buildings as are liable to harbour rats and by instituting a thorough system of scavenging which will diminish their food supply.

During the three years, the flea counts on rats showed a very constant seasonal variation from about two fleas per rat in the hot weather to an average of nine per rat for the month of September. The months of high humidity are particularly favourable to flea multiplication, while dry hot weather is unfavourable.

We have been able to keep a close watch on imported cases of plague; our experience has shown that a large number of persons have come to Poona from infected places. The present epidemic in Poona City has been started by persons carrying the disease with them from Lonacla, where an epidemic existed for some weeks before it was known to the authorities. The experience we have had in Poona has fully convinced us of the enormous importance of what we have called "the importation of infection" and the urgent necessity for a better system of intelligence, so that early information can reach the authorities of the outbreak of an epidemic disease. How this can be

accomplished is a pressing problem in plague prevention and in all Indian sanitation, and certainly deserves the attention of this Conference. At one time as many as eighty persons were coming to Poona City daily from the plague-infected centres; most of these, and we wish to emphasise it, were refugees from infected towns or villages. Fortunate it is that plague infection is carried from place to place only with difficulty.

The present epidemic started in three well-defined foci, and is spreading from the infected areas to other parts of the town (a) by direct rat to rat infection; (b) by the carriage of infection by persons coming from the infested areas to healthy parts of the city.

The epidemic is at present not severe (1) because the conditions are daily becoming less and less favourable for flea multiplication—the epidemic started with a falling flea prevalence; and (2) the number of rats, which are immune to the disease, is very large, more than 70 per cent. of them are immune to a moderate dose of virulent plague bacilli; (3) the number of foci of rat infection is still small. Should the disease continue to prevail during the coming quiescent season and the number of foci of infection increase, a moderate to a severe epidemic may be predicted during the next rains when the conditions are favourable to flea multiplication.

(c) *Work in the United Provinces.*

In the beginning of this year work was started in the United Provinces. The work has been undertaken with the object of solving if possible certain apparently obscure problems connected with the distribution of plague.

The questions to which we are endeavouring to find answers are—

- (a) Why has Cawnpore persistently suffered from more severe and more frequent epidemics of plague than has the adjacent city of Lucknow? Why do Cawnpore epidemics almost invariably commence some months earlier than the plague epidemics in Lucknow?
- (b) In the Ballia District, what are the factors which account for the severity of plague, greater here than in any other district of the United Provinces?
- (c) Why have the Bundelkhand Districts of the United Provinces escaped infection from plague?
- (d) What accounts for the greater severity of plague in the Muttra and Muzaffernagar Districts as compared with the other Western districts of the Province?

There are other questions of minor importance that will engage our attention, and it is too early yet to make final and definite statements about any of the questions raised above. Several facts of interest, however, have already come to light, and we may refer briefly to them.

Before doing so we would draw attention to the remarkable and sometimes very large discrepancies between the plague statistics published by the Sanitary Commissioner and those of the Special Plague Reports of the United Provinces. A difference of fifty per cent. in the figures is not unknown. The matter, we think, is one worthy of consideration by a Conference of this kind, and for this reason we mention it.

(a) Let us proceed to the results of our inquiry in Cawnpore and Lucknow. These two cities, separated by less than fifty miles and possessing climates remarkably similar, have plague histories that present striking differences. Epidemics in Cawnpore have been more severe than those in Lucknow. Most of the severe epidemics in Cawnpore have commenced in the autumn months and reached their height in December or January. Those in Lucknow have never attained their height before March or April. In this connection Lucknow is typical of the United Provinces as a whole, Cawnpore being a striking exception. Of late years there has been a slight tendency for Cawnpore epidemics to approximate in type to those of other places in the United Provinces, but they still occur early.

An examination of rats and fleas was commenced in Lucknow in January and in Cawnpore in February. Without going minutely into figures it can be stated that :—

- (1) Rats (*M. rattus*) are very much more numerous in Cawnpore than in Lucknow (probably twice as numerous).
- (2) Fleas are persistently more numerous on the Cawnpore rats than on the Lucknow rats, and the post-monsoon rise in the number of fleas takes place several weeks earlier in Cawnpore than in Lucknow. The highest flea counts in Cawnpore to date have been approximately seventeen in one week in October and one week in February. In Lucknow the figures are about twelve in the same months. The minimum flea counts were obtained in June, when 2.5 fleas per rat were noted in Cawnpore and approximately two in Lucknow.
- (3) Rats in Cawnpore are at the present time much more immune to plague than they are in Lucknow, a reference has been made to this when immunity to plague in rats was under consideration. Thus, while only twelve per cent. of Cawnpore rats died of plague, thirty-seven per cent. of Lucknow rats succumbed to the same dose, this dose killing ninety-five per cent. of rats from Madras. The rat flea that is most in evidence in both these towns is *X. cheopis*. *Ceratophyllus fasciatus*, or an allied species, is fairly often found in Lucknow on rats during the cold weather, and was very much less frequently met with in Cawnpore. This species of flea disappeared completely with the onset of the hot weather and to the present date has not re-appeared. Factors of very special importance in connection with the Cawnpore and Lucknow problem appear to be—

(1) Crowding and congestion of people and houses in Cawnpore is much greater than in Lucknow.

(2) Cawnpore is a very large grain collecting and distributing centre. This latter factor we believe is of importance in maintaining the large rat population of that city and exposes it to early infection from surrounding infected areas. Grain and fodder we know are well recognised media for the distribution of infection either by the rats or the fleas which find shelter in them.

(b) Work was also started in the Ballia District early in the year and observations on rats and fleas have been made in several towns and villages on lines similar to those in Cawnpore and Lucknow. Our work has, however, met with several interruptions owing to the opposition of the people to trapping, but, in spite of these, some facts of interest have come to light.

Flea counts in this district have never fallen so low as they have done in Cawnpore and Lucknow. A flea count of nearly six per rat was noted at Bansdih in July, a time when the count in Cawnpore and Lucknow approximated to only three. Possibly, as a consequence of this sporadic cases of plague, during the non-epidemic season, are more frequent in this district than in other districts in the United Provinces. This is a matter of importance in connection with the severity of the disease in this district, for the more numerous the foci of infection the greater are the opportunities for the spread of the disease, especially at a time when fleas are becoming more numerous.

(c) The plague-free district, Banda, in Bundelkhand was also selected for observations. Work has been going on there for the past two months. Trapping in Banda town has revealed the somewhat surprising fact that both rats of a high degree of susceptibility and fleas are present in abundance. If the present high flea count is maintained in Banda throughout the cold season the explanation of the immunity of this district from plague will be difficult and the inquiry is expected to be of special interest and importance.

(d) The fourth problem, the severity of plague in Muttra and Muzaffernagar, has not yet been investigated on the spot.

Much laborious work has been done on the relation between meteorological conditions and the severity and the distribution of plague in the Province. It is abundantly clear that humidity and temperature are factors of great importance. But it is exceedingly difficult to assign to either its relative value.

(d) Observations in the Madras Presidency.

During the past six months the Commission have also been engaged in the Madras Presidency. Here, as in the United Provinces, the problem we have set ourselves to solve is the peculiar geographical distribution of the disease. We wish particularly to find out why a large part of the Madras Presidency has escaped infection while most of the rest of India has been severely smitten.

It has been urged by some that the Madras Presidency has escaped because, relatively to the amount of plague present in the Presidency, a far greater sum has been expended on plague preventive measures in Madras than in any other Presidency or Province. Up to the end of 1909 more than half a million sterling had been spent in keeping plague at bay.

The question resolves itself into finding out whether the comparative freedom from plague has been due to these measures or whether these measures have been materially assisted by the natural conditions which exist in the Presidency and which themselves are less favourable to the spread of the disease. We are not yet in a position to give the answer but the following is a brief summary of our observations to date.

In Madras City rats are numerous and are, as we have seen, extraordinarily susceptible to plague. *Mus rattus* forms approximately fifty per cent. of the rodent population of the city, the remainder of the rodent population is made up of bandicoots and mice. But while rats are numerous, the number of fleas found on them is low compared with places where plague has been epidemic. For less than two months in the year an average of five fleas per rat was found. This is the maximum figure and can be compared with eighteen per rat in Belgaum, seventeen in Cawnpore, fourteen in Lucknow and eleven in Poona.

In May of this year observations were commenced in Madura and Coimbatore. The former city has never suffered from plague, and here, although rats are numerous, fleas are scarce. On the other hand, in Coimbatore, situated more than 1,000 feet above the sea level and enjoying a climate cooler than that of Madura, rat fleas are more numerous and the town has suffered from several epidemics of plague. On an average during the month of September as many as 10 fleas per rat were noted.

Observations have been made at a number of other places, among them Vaniyambadi and Deccanikota. The former town is situated about 2,000 feet, while the latter is more than 3,000 feet above the sea level.

Vaniyambadi has had one severe epidemic of plague which lasted for nearly two years destroying during that time nearly one-quarter of its inhabitants. Since this epidemic the place has been free from plague. Rats, even now, seven years after the epidemic, are comparatively scarce, in the town only 10 rats being caught in every 100 traps set.

Deccanikota on the other hand is situated on the Mysore plateau where plague has been present for many years. Here the number of fleas found on rats is greater than that found in any other part of the Madras Presidency.

So far as our work at present goes it seems as if that part of the Madras Presidency which is situated below an elevation of 1,000 feet has escaped plague largely because of the scarcity of the fleas on the rats and this again appears to be due to the climatic conditions.

Some interesting observations have been made at Coonoor and Ootacamund. Here the species of fleas found on rodents differ remarkably from those of the plains.

In Coonoor mice are very numerous and rats are comparatively few. Four hundred and seventy-three mice were caught with only 50 *M. rattus*, and the common mouse flea *Ctenophysylla musculi* is found both on mice and on rats. This flea is very rarely found in other parts of India. Field rats are also numerous and on them a new species of flea has been found which is closely allied to *Pygeopsylla ahalae*. A species of flea was also found on *M. rattus* which closely resembled *Ceratophyllus fasciatus* and which has been identified by Rothschild as *C. alladines*.

Observations are now being extended to Calicut, Palghat, Trichinopoly and certain other towns in the Presidency.

PART III.

In conclusion we review our work in the hospital.

Through the kindness of Dr. Choksy we have been able, during the past three years, to carefully study some 444 cases of plague. Exactly half this number were treated with anti-plague serum in varying doses given both intravenously and subcutaneously and the other half were retained as controls under ordinary treatment. The treatment of the patients in the two groups of cases was similar except that the patients of one group in addition were treated with the anti-plague curative serum. There were 222 cases in each group. The case mortality in the serum-treated patients was 66.1 per cent., in the control cases 73.4 per cent. This shows a slight advantage to the serum-treated

cases, but a further analysis considerably minimises this advantage. Cultures from the blood of every case were made daily from the day of admission till the recovery or the death of the patient and the two groups of serum and control cases were further sub-divided according to the result of the examination of the cultures taken immediately before treatment was begun as follows :—

- (a) those without any bacilli in one quarter of a cubic centimeter of their blood ;
- (b) those with less than ten bacilli in each quarter of a cubic centimeter of blood ;
- (c) those with over ten and less than one hundred bacilli in each quarter of a cubic centimeter of blood ;
- (d) those with more than one hundred bacilli in a quarter of a cubic centimeter of blood.

Here we may state that no case in groups (c) and (d) whether among the serum or among the control cases recovered. We have therefore to consider only groups (a) and (b) to apprise the value of the serum treatment.

Among the serum cases 85 belonged to class (a), that is, had no bacilli in their blood at the beginning of their treatment while there were only 70 of this class among the controls. Again among the serum group in class (b) there were only 43 cases while there were 47 cases among the controls. There was thus a slight advantage in favour of the serum cases when the severity of the disease in each group is considered. The subjoined tables clearly demonstrate the results obtained.

It may be said that clinically one could observe that the serum modified the course of the disease : life was prolonged and the bacteria tended to diminish in numbers in the circulation becoming localised in the tissues where they caused necrotic nodules and abscesses.

A reduction in the degree of septicæmia occurred in fifty-three of the serum cases and in only thirty of the controls. It would seem then that, in a case that was hanging in the balance between recovery and death, the serum fortified a little the resisting powers of the patient, but, where a patient would have in any case recovered, the severe urticarial and painful erythematous rashes and the arthritis produced by the serum prolonged his stay in hospital and added to his discomfort. These results are by no means encouraging, but we have a ray of hope in the fact that certain experiments conducted in the laboratory of the Lister Institute by Dr. Sydney Rowland with a serum prepared by a new method has yielded much more satisfactory results when tested on infected rats. Some of this serum is now in my hands, and I hope to have an early occasion for trying it on men.

Serum Cases.

					Actuals.					Percentages.			
					A	B	C	D	Total.	A	B	C	D
Survived	...	...	...	...	63	12	0	0	75	84·0	16	0	0
Died	...	...	...	...	22	31	18	76	147	15·0	21·1	12·2	51·7
Total	...	...	...	...	85	43	18	76	222	38·3	19·4	8·1	34·2

Diminution of Septicæmia	{	Survivors	...	...	...	...	11
		Died	...	...	...	...	42
Case mortality,							53

Control Cases.

					Actuals.					Percentages.			
					A	B	C	D	Total.	A	B	C	D
Survived	...	...	...	...	46	13	0	0	59	78·0	22·0	0	0
Died	...	...	...	...	24	34	24	81	163	14·7	20·86	14·7	47·63
Total	...	...	...	...	70	47	24	81	222	31·5	21·1	10·8	36·4

Diminution of Septicæmia	{	Survivors	...	...	...	...	13
		Died	...	...	...	...	17
Case mortality,							30

CONCLUSION.

In conclusion, gentlemen, I trust that I have made it clear that, although the Plague Commission have done much to advance our knowledge of plague, there still remain problems worthy of study and that success in the elucidation of these problems is only possible when laboratory work is combined with epidemiological and clinical inquiries.

I have purposely said little about preventive measures ; these, after all, are of first importance. But the carrying out of suitable measures in so vast a country as this can only be accomplished by those who have an intimate knowledge of the very varying customs, habits, and temper of the people in the different parts of it. It therefore remains for you, members of this Conference, to suggest and carry through such measures as your experience of the people in your several Provinces permits you to believe are practicable, bearing in mind always that few measures can be successful which are

not based on a true knowledge of the ætiology of the disease. A study of the disease must first be made and preventive measures can then be based on the knowledge gained. It has been our duty to study plague ; it remains for you to devise practical measures for its prevention.

(Signed) W. GLEN LISTON, *M.D., D.P.H., Major, I.M.S.,*
Senior Member, Plague Research Commission.

PAREL ;
 The 4th November, 1911.

APPENDIX 17 to No. 4.

PASSPORTING OF GRAIN AND GRAIN GUNNY BAGS FROM LOCALITIES INFECTED WITH PLAGUE.

My reason for bringing this forward is on account of the frequency with which I have observed that outbreaks of indigenous plague have very frequently occurred in grain godowns or in their immediate vicinity. Examples of this which have come under my personal observation existed in Calcutta in 1898 in and around grain godowns of Kidderpore. It seemed to me a curious coincidence that the outbreak in the southern divisions of the city which are separated by a broad maidan and Tolly's Nullah from the northern sections should occur simultaneously in each. The rat itself could not be the means by which infection was carried owing to the risk to its life which such a journey would involve. That some other means of conveying infection must exist was strongly impressed upon me, and I concluded then that the vehicle of infection was grain. In the light of more recent knowledge and working on the flea theory of the spread of plague I venture on a hypothesis that the infection was conveyed by means of the flea in the grain or gunny bags. In support of this we have also the case in this Presidency of the Bellary town. In this instance the oilseeds were imported from a locality well-known to be infected in the Nizam's dominions to the railway goods-shed in which after about a week an epizootic amongst the rats was discovered. The disease next appeared among the people in the town in the shops of Cowl Bazaar where this oilseed was retailed.

It is a well-known fact that the rat population of these grain godowns is much greater than that of any other class of building. Systematic trapping of villages has shown that the rat population is greater in grain godowns and grain shops than in any other class of building. The number of rats which can be got in these godowns is much greater than can be obtained in dwelling houses and small bazaar shops which do not sell grain. This is a matter of very common experience. One can go on trapping these godowns over and over again and still continue to catch rats. These godowns present every condition favourable to the spread of a virulent epizootic provided there is a sufficient flea prevalence.

Up to date no really satisfactory regulations for the control of plague from infected localities have been made in accordance with the latest finding of the Plague Commission. The last interim report contains the following statement :—

“Plague appears to be commonly imported into a fresh locality about the persons of human beings, though the transference of infected rats and fleas in merchandise must be considered.”

In the Madras Presidency at present a system of passporting individuals from plague-infected localities is carried out at great expense and is based upon ideas which have undergone considerable modifications since the scheme was first drawn up. This passport system would probably require considerable modification to bring it up to modern ideas on plague prevention for while exercising a supervision over the individual it entirely neglects the other possibility of the carriage of plague in merchandise. The possibility of the transmission of infection in merchandise more particularly the grain bags is one which must have occurred to any one who has watched the spread of plague in districts.

The rat population in grain godowns is so great that in the event of infection appearing amongst them the number of infected fleas which must necessarily fall on the grain and gunny bags must be considerable—

- (2) The frequency with which plague spreads to the district after shandy would lend colour to the idea that infected fleas are transported in merchandise. The possibility however of the human factor here cannot be neglected.
- (3) Gunny bags possibly contain infected fleas or plague-infected dead rats, and this makes it very important that such gunny bags being sent from infected localities should be observed in some way.

If the above hypothesis after experiment proves to be correct I would suggest for your consideration some method of passporting these grain bags :—

- (a) These bags should be ticketed—the name of the town or village and date of export.
- (b) Before entering a non-infected locality they should be submitted to sun or cyanide disinfection in accordance with the recent memoirs on the subject of flea destruction.

Such a method would be much easier to carry out than observation of individuals and would give less trouble to the people. We have frequently found in districts which have been infected previously that the villagers will not allow newcomers from infected villages to enter their villages and will scarcely give them food. In the Bellary district a tahsildar's son came to visit his father from an infected locality. The villagers sternly refused to allow him to enter the village and he was kept outside the village four nights. This is only one of the many instances reported. People would be even more likely to exclude grain if it were possible to know that it came from infected localities. In the ceded districts of the Madras Presidency very much the same conditions as to temperature and humidity prevail throughout. Here Bellary district has been infected since the year 1898 and the neighbouring district of Kurnool has been free for six years. The Collector of the district informs me that very little grain is imported into Kurnool district and this in my opinion must have considerably helped to bring about this state of affairs.

I would suggest this is a suitable line for research by the Plague Research Commission.

(Signed) W. A. JUSTICE, *Captain, I.M.S.*

APPENDIX 18 to No. 4.

ACTION OF HYDROCYANIC ACID GAS ON GRAIN AND OTHER FOODSTUFFS.

This paper is the outcome of a request from the Director General, for a note on the action of Hydrocyanic Acid Gas on grain and especially rice. It seems that there is some ground for the belief that the recrudescence of plague in Persian Gulf Ports is due to the importation of rats in rice bags. Therefore it becomes of importance to fumigate vessels carrying rice in such a manner as to kill the rats and the fleas on them without injuring the cargoes.

The Bombay Port Health Officer in a letter to the Secretary to the Bombay Government, General Department, draws attention to the ineffectiveness of the present methods of fumigating a fully laden vessel, and quotes from the report of Dr. Wade to the local Government Board (May 7th, 1906) to the effect that "the problem of fumigating a ship in order to destroy rats, &c., without damaging the cargo . . . is as yet unsolved."

In Bombay Sulphur Dioxide Gas is used for disinfection purposes. The strengths of that gas which are effective, viz., 3 per cent. for 8—12 hours, are injurious to wheat but leave barley and maize unaffected. So far as I am aware the effect on rice has not been noted.

In Hamburg, Carbon Monoxide is used for fumigation and probably its action on rice is innocuous. But there are two serious objections to its use:—(1) The large cost of the plant and of its installation. (2) The gas does not destroy fleas. This may not be a serious objection as by the time the boat conveying the rice bags reaches the gulf, the fleas may have died of starvation.

Of the two other gaseous agents mentioned by Wade in his report, Carbon Dioxide is expensive and its use is open to the same objections as that of Carbon Monoxide. Formaldehyde vapour is said to be non-toxic to rats and insects.

The action of Hydrocyanic Acid Gas has been to some extent discussed in a paper in the Scientific Memoirs. From the reviews of that paper it is evident that the fear of the lethal action of that gas on men is very strong. Now, while in the Memoir, the gas is not recommended for indiscriminate house disinfection, it is stated that disinfection of clothes in a properly built godown should, with proper precautions, be attended with little or no danger; and the paper was written as a request for permission to use the gas experimentally in selected native houses. Such an experiment was not possible without sanction.

In our opinion what is true of the disinfection of clothes applies even more strongly to ship disinfection, though no experiments have been carried out in this direction.

Hydrocyanic Acid Gas has been widely used all over the world for ridding orchard trees of their pests and the disinfection of nursery stock. In fact in certain of the States of America its use is compulsory. In South Africa, jails have been fumigated with this gas to get rid of bed bugs, and in 1901, in a report of the Government Entomologist to the Cape of Good Hope, it was stated that "the use of the gas for the destruction of vermin in sleeping carriages of the Cape Government Railways has now been practised for three years with perfectly satisfactory results and without any accident." The precautions possible on land are even more possible, we think, on board ships.

The great danger of all these poisonous gases is not actually at the time of generation, but later, when one wishes to open a building or ship for ventilation. With Sulphur Dioxide the fumes are a sufficient indication of the presence of the gas, but with Carbon Monoxide there is no such indication. The latter is very poisonous for man, causes unpleasant sensations in minute quantities; and there is no chemical test to detect the presence of small traces of the gas. It must be determined by animal experiments. In Hamburg living mice in cages are lowered into the hold, left for two hours and the physiological effects on them noted.

It is quite otherwise with Hydrocyanic Acid Gas. By the Prussian Blue test we can detect the minutest traces.

The action of the gas may be considered under the following heads:—(1) On rats and on rat fleas. (2) On foodstuffs. (3) On fabrics.

I. The action on rats and rat fleas was considered in the Memoir from two points of view:—(a) The disinfection of ordinary non-airtight houses. (b) The disinfection of clothes to get rid of fleas. This would be carried out in special airtight godowns.

In the disinfection of a ship's hold the conditions approach those in a comparatively airtight godown.

We shall detail one of our latter experiments. Into a comparatively airtight room of 830 cubic feet capacity 4.38 cubic feet of gas diluted with air were pumped in (equivalent to about 1½ ounces of the 98 per cent. potassium cyanide salt to 100 cubic feet air space) and allowed to act for 20 minutes. Fleas in all parts of the room were killed, even though the tubes containing them were wrapped up in several layers of thick sheeting and blankets. Fleas put in cases with bran and sand at the bottom were all killed showing that the gas does to some degree penetrate. Larvæ and eggs of fleas were found to be very susceptible to the action of the gas, cocoons being more resistant. On rats, even in rooms not at all airtight, the effect is very lethal, but in burrows the gas to be effective has to be pumped into their inlets. If the gas be simply generated in capsules in the rooms it does not enter the burrows.

With reference to the question of disinfection of ships' holds we have to consider first whether there are holes or crannies in which the rats may take refuge. If there are, unless tubes are led into them the rats will not be killed. Secondly, whether the gas will penetrate deeply into bags of rice. Experiments are required on these points before definite statements can be made.

II. The action of the Hydrocyanic Acid Gas on foodstuffs:—

It is generally agreed that dry grain is not made poisonous by the action of the gas. (Report of Entomologist of Cape of Good Hope, 1901.) We made one experiment on this point. Gas which killed fleas in five minutes did not affect bajree, wheat, jowaree, radish seeds or rice. Monkeys, rabbits, hens and pigeons were fed on the grains for 24 hours and remained quite well. Chapatis made of the wheat, jowaree and bajree were given to monkeys and hens with no ill results.

On the other hand moist food-stuffs such as water, milk, butter and flesh are said to absorb the poison.

The gas does not affect the germinating powers of the grains we experimented with, namely, bajree, wheat, jowaree and radish seeds. Rice, however, we did not try, as we were working with milled rice.

III. The gas has no action on metals and fabrics.

(Signed) W. D. H. STEVENSON, *Captain, I.M.S.*

APPENDIX 19 to No. 4.

MEMORANDUM ON THE MANUFACTURE OF GLYCERINATED CALF LYMPH AND LANOLINE VACCINE.

While on furlough last year I availed myself of the opportunity of visiting the Vaccine Institutes at Hong Kong, Tokio and the Local Government Board Depôt at Hendon. At Hong Kong the manufacture of calf lymph is on a very limited scale and follows the lines employed at Hendon, and need not be referred to further. I propose to give a general outline of the manufacture of glycerinated calf lymph as carried out at Tokio and Hendon and in addition any information from other sources I possess bearing on the subject, and finally a brief outline of the methods at each institution and a note on the manufacture of Lanoline paste at the King Institute of Preventive Medicine, Guindy.

Selection of calves.—It goes without saying that the calves must be robust, free from disease, of clear eye, shiny coat, moist nose, &c., skin soft, silky and supple. Black calves or calves with pigmented, pimply or rough skin are to be avoided. Roan calves are specially desired by Hendon, and after that red or red and white. It would appear that red and red and white or light coloured calves are the most common type in all countries. Age 2–4 months old or older. In southern Germany young uncastrated bulls, aged from 6 months to two years, are used. The size of the animal in Europe and Japan is greater than the small calves of Madras. There is much to be said in favour of a large animal being used. The amount of pulp obtained is greater and consequently a fewer number of calves are used, which is economical. On the other hand with a large animal there is a greater risk of tubercle and subsequent loss of the pulp. The smaller animal is much more readily handled.

Sex.—Females are more suitable than males solely, however, with reference to cleanliness. When bulls are vaccinated it is stated by the Director, the Local Government Board Depôt, Hendon, that “the lymph collected from the surface of the scrotum is of greater activity than other lymph” and therefore this practice increases the value of the lymph.

Care of the calves on arrival at the Depôt.—Calves as a rule are obtained from contractors who are not particular where they get them and, being sparingly fed beforehand, are apt to indulge in the good food provided for them at the institutes, and many losses have occurred by the attendants giving them too much fodder in the mangers. Feeding therefore is of great importance during the stage of quarantine which is usually five days to one week. This also allows the animal to overcome the effects of a journey before being submitted to the operation of vaccination.

In England the condition of calves at different seasons of the year varies and has an appreciable effect on the quality of the lymph. During June and in the spring of the year this is especially noticeable when a distinctly superior quality of lymph is obtained and may be attributed to the abundance of fresh fodder. In Madras the condition of the calves in the hot months is poor owing to the scarcity of fodder.

Post mortem examination.—No *post mortems* are held on our calves in Madras. At Hendon since 1899–1909 the total number of calves inoculated was 6,067; of these 47 were at the *post mortem* found to be tubercular, in 77 per cent. of these the infection was limited, in 50 per cent. of cases to a single mesenteric gland. The calves in India are less liable to tubercle owing to continually being in the open air. No *post mortem* is held in Japan but the calves are subjected to the tuberculin test. In Cologne in Germany the calves are slaughtered a few minutes before the pulp is collected.

Original lymph.—The lymph used for inoculating calves ought to be the very strongest. The best stock lymph is derivable by the cultivation of small-pox virus through four to five calves and continued without admixture (see experiments by Colonel W. G. King, I.M.S., reported in Proceedings of the South Indian Branch of the British Medical Association, for April, 1891). At Guindy each day one or more calves, according to requirements, is vaccinated by direct insertion from selected vesicles on a calf previously vaccinated in a similar fashion. The resulting lymph may be called the stock seed lymph. In Tokio the vaccinated surface is made smaller, *i.e.*, the proportion to be inoculated is three square centimetres for every four kilogramme of the calf's weight—the lymph to be used is mixed with diluted glycerine containing 1 per cent. of carbolic acid, in the proportion of 1 : 4. In some German vaccine institutes rabbits are employed, the lymph collected from four rabbits usually furnishing enough pulp to vaccinate a calf. For this purpose also lymph is frequently taken from the arms of children at the public stations—human lymph thus obtained is mixed with glycerine and water—four children affording enough material for the vaccination of a calf.

Operation.—The region operated on is usually the calf's belly. In Hamburg the belly is not vaccinated, only the perineum and the right side of the animal to its shoulder. The amount of surface shaved varies with the size of calf and the amount of lymph which it may be expected to produce. The toilet of the shaved surface varies; some using antiseptics whilst others are content with soap and water and thorough cleanliness. When the toilet is completed the parts should be kept covered with a sterilized cloth or cloth wrung out of carbolic lotion until the time of inoculation.

Inoculation.—After removing the cloth the prepared part is scarified with a lancet and the lymph rubbed in with an aluminium spatula or by the fingers. The incisions are made *en echelon* from $\frac{1}{2}$ to 1 inch apart. Colonel King, I.M.S., recommends that lymph from the stock calf should be introduced into each line carefully by running along it a painter's flexible steel palette knife moistened with lymph.

If it be wished to inoculate a calf with lanoline vaccine, any blood or serum oozing from the scarifications should be removed by clean (sterilized) blotting paper and the paste should then be carefully inserted by the rounded end of a thin spatula into the entire length of the lines whilst making them gape line by line; that is general plastering over the whole surface must not be

practised. The puncture in unskilled hands is not to be recommended; if followed it must be seen that such valve-like flap of skin made really contains a small portion of the paste, otherwise the making of each puncture will simply clean the lancet, leaving the paste on the skin where it can have no effect; but for starting stock for which lanoline vaccine is most valuable, punctures should be used by preference. (Colonel King.)

After insertion of the paste, the calf should be retained on the table for at least half an hour to permit of absorption. After the operation the abdomen should be covered with a clean cloth or bandage which must not be tied too tightly. The calf is provided with a collar which prevents his licking the inoculated part, or the stalls in the stable are so contracted as to prevent him doing this.

The depth of the scarification varies with the thickness of the skin—the general rule is to cut not so deep as to draw blood. If too large a quantity of serious fluid should come out, it must be carefully wiped off with a piece of clean sterilized cloth and then the lymph rubbed over the scratches.

Collection of the pulp.—The time at which the pulp is collected varies—in hot countries and in hot weather the vesicles ripen more quickly. It may be put down as from 72 to 120 hours.

Removal of the vesicle for pulp.—Vesicles intended for preparation of pulp should be removed not later than the 120th hour, or at such time as the vesicle formation is complete and is of a pearly glistening white aspect and showing only the slightest visible attempt at umbellification as could be represented by a thin dark line running down the centre of the vesicles. All vesicles showing any degree of opacity or prominent umbellification with formation of crusts in the centre must be discarded.

The toilet of the belly before collecting and the method of preparation of the pulp varies in different places, but the general idea is the same, *viz.*, its collection under scrupulous cleanliness. This and the subsequent treatment of the pulp after removal is described under method of collecting tissue at each institution.

The average amount of pulp collected per animal varies greatly: 6–17 grammes in calves and in bulls from 15–40 grammes.

Glycerine lymph.—The pulp when it is collected is saturated with glycerine and water in proportions generally of from equal parts to 4 of glycerine and 1 of water; the resulting emulsion finally containing 1 part of pulp to 3 or 4 of the glycerine and water mixture. Very active lymph is further diluted in some cases up to 1 in 9.

The pulp from as many as eight calves may on occasion be amalgamated—as a matter of experience I understand it is found that a uniformly active lymph is in this way produced, any less active lymph in the group becoming incorporated with that which is more active. The whole is placed in a sterilized tube with cork and kept at a temperature of 15° C., for one week. It is then placed in a cold storage. The cold storage is at a temperature of 20° below freezing point. Lymph after two years in a cold storage gave 99 per cent. success in England.

LANOLINE VACCINE.

The pulp should be weighed in the glass pan in which it was collected and at once be transferred to an agate mortar. In this it should be carefully pulped until it is impossible to distinguish one particle from another; on spreading it out with the pestle, it should be absolutely homogeneous. The careful and patient effecting of the process is absolutely necessary.

Anhydrous lanoline (Benno Taffe and Darmstaeder, Martinikinfedle, near Berlin) of absolute purity and neutrality should then be mixed in the proportion of 1 of the vesicle pulp to 6 of lanoline. They should then be mixed in a small glass mortar by means of a painter's steel flexible palette knife. This should be persevered in, till no shade of doubt can remain that the pulp and the lanoline are completely and evenly mixed. The process should be so complete, that not a single particle of any pulped matter should be visible in the lanoline. It is no use attempting to remedy mistakes as to complete pulping of the vesicles by pounding after the admixture of lanoline: the pulping must be perfected before its addition. (Colonel W. G. King, I.M.S.)

The greatest trouble exists in maintaining the lymph at its highest efficiency. The condition of the calves for one thing; when fodder is scarce and their condition not so good, there is deterioration in the lymph. Again, it is said the passage of the virus through a number of calves weakens the effective power of the lymph, and finally that animal lymph contains a very small quantity of the virus. Mr. Umeno, under the direction of Professor Kitasato, claims that the cause of calf lymph becoming non-effective was due to the wrong method of inoculation. He states as follows:—The quantity of virus in animal lymph is much greater than in humanized lymph. Unless, therefore, it is diluted before inoculation, the very existence of superabundant virus will hinder its growth. The portion of the calf's body inoculated should be small and the vaccine must be carefully nourished, otherwise its effective power will not be preserved." If, therefore, the lymph is sufficiently diluted and inoculated into the belly of a calf over a small surface, it will continue to produce the same result, however often it may go through the calf's body.

INOCULATION OF RABBIT.

The whole side of a rabbit is shaved very carefully on account of the thinness of the rabbit's skin. The rabbit is held by an assistant, and, with a wooden match, the surface of the skin is rubbed over till a slight erythema is produced, the lymph from the stock is then rubbed over the surface with a spatula. The vesicles mature in three to four days. The rabbit is then killed, the skin stretched and the lymph removed.

PLATING OUT ON AGAR.

A platinum loopfull of the lymph is rolled up in a tube of agar, and transferred to a Petri dish. The dish is then placed in an incubator at 37° C. for 48 hours, and for the rest of a week at room temperature. The colonies are then counted and search is made for any colony which may appear to be suspicious. As a rule no other colonies, except those of *Staphylococcus albus* and *aurius* are detected.

LYMPH INSTITUTE, TOKIO.

Calves are from two to four months old, and are examined by the tuberculin test. No *post mortems* are held after removal of pulp.

Method of inoculation.—The hair of the belly is shaved, the parts are thoroughly disinfected with soap and alcohol, and the skin wiped with sterilized cotton. The scarifications are made by a special instrument invented by Dr. Umeno, and over these cross scarifications are made with the same instrument. The lymph is then rubbed over the scratches. The belly is then covered with sterilized cotton on which a cotton wadded cloth is placed, and the calves led into the stable.

Method of collecting tissue.—The inflamed portion is first moistened with sterilized water, then washed with soap and three per cent. carbolic acid solution rubbed with a piece of cotton, and the moisture carefully wiped off with a piece of sterilized cotton. Standing on the left of the calf, which has been placed on its back, the skin is pressed from a little behind the row of the vaccinated portion with a stretcher in the left hand (an inverted T with a handle), while, with a lymph collector shaped like a broadened out Volkman's spoon in the right hand, the vesicles are scratched off from the hinder part towards the front. Then the rows of vaccine vesicles thus scraped off one by one are put in a dish. When this is all finished, a mixture consisting of 10 parts of iodoform and 90 parts charcoal dust is put over the wounds.

Mode of preparation.—The pulp thus obtained is weighed and ground by Doering's lymph grinding mill. When it is sufficiently ground, the carbolic acid-glycerine is mixed with the vaccine in the proportion of four to one, the result being five times diluted lymph. A glass tube with a stopper at the bottom is used to remove the spume or froth. The spume is easily removed by turning it in a centrifugal apparatus, when it will come up on the surface. After removal of the spume the stopper is taken off and the fluid collected. When this is done a perfect lymph is produced. It is then put into lymph tubes by a lymph sucker by agile assistants and sealed at both ends. The lymph sucker is a glass tube, having a rubber ball at one end and at the other a rubber stopper with a small hole in the centre, into which a lymph tube is inserted in order to fill it with lymph. The rubber ball has also a small hole which is intended to regulate the passage of the air by the motion of a finger placed upon it.

A set of the instruments used at Tokio Calf Lymph Institute will be shewn.

L. G. B. INSTITUTE, HENDON.

Calves are obtained from Ireland by contract, they are examined on arrival in England by a Veterinary Surgeon of the Agricultural Board for any infectious disease. The tuberculin test is applied. The calves are between the ages of three to four months—a month or two older in some cases. They are kept under observation for one week. After the operation an autopsy is made by a veterinary surgeon. The finding of tubercle excludes the use of the lymph from that calf.

Method of inoculation.—The belly is shaved, the amount of surface shaved varies with the size of calf and the amount of lymph which it may be expected to produce. Bull calves are preferred—the scrotum is most carefully shaved and is a fertile source of the best calf lymph.

Toilet.—The shaved portion is most carefully washed with soap and water and then with sterilized water. Inoculation is performed with a lancet and the lymph rubbed in with an aluminium spatula. The area inoculated varies with the size and condition of the calf. Calves are inoculated on Friday and pulp collected on Wednesday.

Method of collecting.—The parts are well washed with soap and water and then well washed with sterilized water, sterilized cotton gauze is used for drying the parts after washing. A sterilized spoon, which is kept in alcohol, is used for scraping the vesicles—the skin being kept tense by an assistant during the operation. The resulting pulp is put in a sterilized bottle and weighed. No dressing is used after the operation.

Method of preparation.—The pulp is ground in the screw (Catalogue, Baird and Tatlock, p. 1235) with four parts of glycerine added making a 1-5 dilution. After thorough grinding the whole is placed in a tube fitted with a sterilized cork, and kept at a temperature of 15° C., for one week, after this time it is placed in the cold storage.

No carbolic acid or disinfectants of any kind are added to the lymph or used in the preparation. It is found, after a long period of research at the laboratories, that the micro-organisms found in the lymph are those naturally present on the calf's skin and can do no harm. On the contrary, they are necessary, and an experiment by Kelsch would support this. He vaccinated one arm of a child with an amicrobic lymph and the other arm with ordinary lymph—the former produced a very inflamed and invisible looking vesicle, whereas the latter ran a very mild and ordinary course. In the cold storage the number of micros is enormously reduced during the first week, after this, although they are reduced—it is to a very insignificant extent—the numbers usually remaining about the same in the cold storage.

(Signed) W. A. JUSTICE, Captain, I.M.S.

The 1st November, 1911.

APPENDIX 20 to No. 4.

CULTIVATION AND PRESERVATION OF COW-POX VACCINE AS PRACTISED AT THE KING INSTITUTE, GUINDY, MADRAS.

Cultivation of the Virus.

This is carried out on calves which are bought from a contractor with whom there is however no definite written contract. He brings, as a rule, about 35 calves once a week and often a truck once a fortnight. His supply is most irregular and cannot be depended on. This is a constant source of anxiety and has in the past led to almost a total stoppage of the issue of vaccine.

The calves on arriving at the Institute are placed in the reserve enclosure and given, if possible, 48 hours' rest. On many occasions this is not possible and they are only given 12-18 hours' rest.

Before being taken over by the Institute they are examined for disease and general suitability. In the old days when there were four contractors supplying calves, it was possible to pick and choose; thus all animals with severe tick-bites were rejected as well as the undersized and weaklings. Owing to the shortage of calves and the constant demand for vaccine it is now only possible to reject the very sickly animals. Those which appear only slightly indisposed are kept a day or two apart, and, if they pick up, are accepted. The contractor is paid Rs. 7-12-0 to Rs. 8-4-0 per calf according to the size and condition of the animal.

The evening before vaccination, the required number of calves are shaved by two expert barbers who are supplied with the best procurable razors. The calves are then transferred to the waiting-shed and are vaccinated as follows:—

The calf on being fixed in the table, the skin of its abdomen is thoroughly cleaned with water and carefully dried with a clean towel. The scarifications are made with a small lancet, the edge of which is sharpened but not made too keen, so as to avoid drawing blood. The cuts are made from 2 to 4 m.m. apart and from 5 to 6 c.m. long; they are always made in groups of three and in all form about 45 to 50 such groups. Before making each cut the point of the lancet is dipped in the seed vaccine—always glycerinated—so that at the moment the cut is made the virus is deposited in it. In calves with very thick skins they should be made to gape so that the vaccine virus readily enters. When the whole are completed, it is customary to go over each group again putting in fresh virus. Three calf watchmen always attend each vaccinator and one should be provided with a fan to keep off flies, and to help in rapidly-drying the cuts. This is important for it is not advisable to keep an animal long on the table. Dislocations and serious cramp have over and over again occurred as a result. The animal on being removed from the table is taken to the paste shed and when the cuts are dry, a clean bandage is attached to the abdomen. Prior to this the tail should be fixed, and a collar placed round the neck, and the animal must not be allowed to lie down.

The calves are first inspected 58 to 60 hours after vaccination, again at about 80 hours and lastly at 96 hours or later. There are always three inspections during the 12 hours and frequently one at night, in this way the vesicles are always caught at their maximum stage of growth.

When the vesicles on a calf are ready to be pulped it is taken to the vaccination room and again fixed to a table. The abdomen is thoroughly washed with water and dried and before the vesicular matter is removed, the scabs overlying it are cut out with a lancet; washing with warm water greatly facilitates this. The operator then seats himself before the calf and with the lancet rapidly scrapes off the vesicular matter and places it in a clean watch glass. The whole is weighed and the weight recorded. It is then placed in a glass mortar or an agate mortar, and slowly and steadily pulped, and ground up till on smearing the substance over a clean part of the mortar, no particulate matter is seen. This operation lasts about half an hour. It is then without any desiccation thoroughly mixed with five times its weight of pure anhydrous lanoline (Liebreich's formula). Each pot of lanoline is tested by the Chemical Assistant to see whether it is acid or neutral, the former are always rejected. The consistency of the resulting mixture is that of a thick sauce, for instance, mayonnaise.

The lanolinated vaccine prepared during the day (7 to 8 A.M.) is next taken to the loading room and packed into clean glass jars which are labelled and stored in ice. Evenness in the quality of the vaccine is secured by mixing the vesicular matter from a number of calves.

In rotation the vaccine which is stored in ice is loaded into tin collapsible tubes holding from 5—150 cases, the nozzles and shoulders of these tubes previous to filling having been dipped in melted paraffin to render them airtight. The tubes are filled by hand from the bottom by means of an ordinary silver probe, care being taken that the vaccine is cleanly pushed down to the screw nipple and shoulder of the tube so that no bubbles of air are left. The excess portion of the tube is cut off leaving about 2 c.m. above the level of the vaccine; this portion is carefully flattened out and bent over several times to occlude the opening. Approximately 27 milligrammes of the mixture is allowed for each case.

In all the process of preparation, cleanliness rather than antiseptic and aseptic precautions are aimed at. It is not claimed for the vaccine that it is free of organisms; these have, however, been examined several times and found to be only the skin organisms present on the skin of the calf.

There are two serious obstacles in the cultivation of cow-pox vaccine at this Institute:—

- (1) Inferior calves.
- (2) Difficulty of maintaining the strain owing to the temperature and the want of an efficient cold store.

With regard to (1) it has already been pointed out the supply of calves is always a cause of anxiety, and owing to the shortage it is impossible to reject the inferior ones. There is no other course open. Undersized and sickly calves are obviously unsuitable for the preparation of cow-pox vaccine; yet it is these that are in the great majority the ones that are used. Further, even a short stay in the Institute where there is no grazing does not improve the condition of even the best calves and the weaklings become weaker. From long experience it has been found that to keep a large reserve of calves at the Institute is courting disaster, and this should not be allowed under any circumstances. Such serious diseases as foot and mouth disease, Piroplasmosis, and fatal and rapid form of diarrhoea probably due to Bovine Coccidiosis can only be avoided by keeping the reserve down, never letting it exceed 100 or thereabouts. Outbreaks of these diseases have occurred in the past and they have disorganised the work.

With regard to (2) it is hardly necessary to point out that in order to carry out the cultivation of cow-pox vaccine it is of the first importance to have good working strain, a strain which gives equable results under all conditions. Such a strain has not yet been found and this is therefore the most disappointing part of the whole work. Colonel King strongly advocated keeping special calves for stock purposes. From experience of the last five years this has been found to be quite impracticable. In the first place good calves cannot be procured; secondly, after a most careful trial of Colonel King's methods in 1909, it was abandoned for the simple reason that no better results were obtained by adopting it. Stock calves were selected and fed on special food, and vaccinated by the single flap method so strongly advocated by Colonel King. The vesicles obtained in this way were in no way better than those seen on calves vaccinated by the three line method described above. It was not

practicable as the yield per calf is small and in order to keep up the reserve of vaccine, the turnover must be a steady one, so that in order to keep pace with the output many calves had to be used for stock; this is a pure waste. Since then the strain is maintained by watching the calves vaccinated each day and selecting the best vesicles and making it into glycerine paste and storing it for short periods into ice; there being no cold store at the Institute.

Here again owing to the temperature and the hot dry winds every strain ultimately deteriorates and no way has yet been found which will enhance its virulence. Donkeys, sheep, rabbits, guinea pigs have been vaccinated and the vesicular matter as well as that from children showing good cow-pox vesicles have been used. Strains have been obtained from England, the Continent of Europe, the Vaccine Institute, Belgaum and Bangalore and also from Burma, but the result is always the same, a steady deterioration. Under such conditions and coupled with the fact that the vaccine is often carelessly used by the vaccinators, good results can hardly be expected.

Lastly, instead of a reserve of calves, a reserve of lanolinated vaccine is always kept; it is stored in ice in large ice-chests. This reserve is sufficient for one month to two months, and when calves are plentiful, enough for three months has been kept. It is imperative to have this reserve to fall back on when calves cannot be got. It can be readily understood that, kept in this way, the temperature cannot be maintained constantly low, but it is hoped when the cold storage installation is ready and in working order to keep the reserve in a properly insulated condition.

(Signed) W. S. PATTON, M.B., *Captain, I.M.S.,*
Acting Director.

KING INSTITUTE, GUINDY;
The 26th October, 1911.

APPENDIX 21 to No. 4.

TUBERCULOSIS.

In inviting discussions on the spread of Tuberculosis in Calcutta I would depend greatly upon the figures I have given in my feeble note on the subject. These figures clearly demonstrate that Tuberculosis is on the rise and that the time has come when strenuous efforts should be made to arrest its further progress. Tuberculosis is more prevalent in towns and cities than in suburbs and villages. Indian females from their peculiar habits and social customs suffer twice as much as males. I have based my paper principally upon the result of my own personal observations. As most of the facts are commonplace things and do not form important subjects for discussion by this learned body, I had better not take up the time of the conference by considering them here. I would simply solicit your valuable opinions on points which affect the interest of Government and the people alike. Taking into consideration the site of Calcutta and its surroundings one would be naturally tempted to know whether in the opinion of this conference the city itself offers facility to the dissemination of Tuberculosis and whether it does not require radical structural changes to make it healthy. It is an admitted fact that Tuberculosis spreads through overcrowding, and prevention of overcrowding is the essence of town-planning. The dust of the streets of Calcutta is impregnated with the germs of Phthisis and when wafted by the wind gets access into the systems of the people through their respiratory tract. In preventing the spread of the disease this conference should, if possible, devise means to admit more pure air by preventing the growth of lofty houses in total disregard to the width of the streets and the construction of rooms despite the elementary rules of the laws of health. This would be easily done by changing or modifying the existing building regulations and bringing the improvement scheme into operation. Men who understand sanitation should only be entrusted with the work. I would respectively urge this conference to consider the desirability of establishing a separate hospital for the treatment of Phthisis and other tubercular diseases. At present, as I have said in my paper, there is no control over the milk supply of Calcutta; there is no means to isolate a diseased cow from her flock; and this conference is to discuss the necessity of removing the evil. The propriety of building suitable houses and huts for the poor working classes of people may be thoroughly discussed. The importance of personal and domestic hygiene should be impressed upon the minds of the people by introducing principles of hygiene into the curriculum of study of their younger generation. These are the points which I think and I believe justly entitle me to court discussion on the subject.

THE SPREAD OF TUBERCULOSIS IN CALCUTTA.

No preamble is necessary to introduce Tuberculosis as a fit subject for discussion amongst the learned members of this conference. The reports of the Sanitary Commissioners of the various provinces, when read with the sanitary reports of the local Governments tend to demonstrate the fact that Tuberculosis is vigorously pushing its way through the crowded streets and lanes of the populous city of Calcutta and no step has yet been taken to resist its course. In spite of all care to improve its sanitation and in spite of all our endeavours to improve the health of its people, we have hopelessly failed to stamp out Tuberculosis. Within the last twenty years it has taken a firm hold on Calcutta and from the rate at which it has been spreading it is no exaggeration to say that at no distant date it will be a very serious problem. The toll which Calcutta and its suburbs annually pay to the assessor of death on this head is simply appalling. We may grudge to pay a penny over the fixed municipal rates to the assessor of the corporation for carrying out certain important improvements, and we may move heaven and earth to rescue us from the oppression, but we are offering no opposition to the demands of the ruthless assessor of Tuberculosis. This inaction is detrimental to the interests of Government and to the well-being of the city itself. I regret that for want of an accurate system of the registration of the causes of death I cannot give here an exact figure of deaths from Tuberculosis and its various forms, but roughly speaking nearly one-eighth of the total number of deaths in Calcutta is due to this cause. From the records of the Calcutta Corporation and more especially from the report of Doctor Pearce, we find that the disease has already spread all over the town and has not even spared

gives the death rates during 1905 from which we find that it was the highest—

Amongst men in Ward No. 4	...	...	...	...	(2.5 per thousand)
Amongst females in Ward No. 14	...	...	...	...	(5.0 " ")
Amongst Mahomedans in Ward No. 4	...	...	...	...	(5.0 " ")
Amongst Hindus in Ward No. 5	...	...	...	...	(2.7 " ")
Amongst Hindu males in Ward No. 1	...	...	...	...	(2.2 " ")
Amongst females in Ward No. 14	...	...	...	...	(4.8 " ")
Amongst Mahomedan males in Ward No. 14	...	...	...	...	(3.8 " ")
Amongst Mahomedan females in Ward No. 5	...	...	...	...	(12.8 " ")
Amongst Mahomedan females in Ward No. 4	...	...	...	...	(7.5 " ")

Amongst men in Ward No. 4	...	...	...	...	...	(2.5 per thousand)
Amongst females in Ward No. 14	...	...	...	...	...	(5.0 " ")
Amongst Mahomedans in Ward No. 4	...	...	...	...	...	(5.0 " ")
Amongst Hindus in Ward No. 5	...	...	...	...	...	(2.7 " ")
Amongst Hindu males in Ward No. 1	...	...	...	...	...	(2.2 " ")
Amongst females in Ward No. 14	...	...	...	...	...	(4.8 " ")
Amongst Mahomedan males in Ward No. 14	...	...	...	...	...	(3.8 " ")
Amongst Mahomedan females in Ward No. 5	...	...	...	...	...	(12.8 " ")
Amongst Mahomedan females in Ward No. 4	...	...	...	...	...	(7.5 " ")

The collection of figures for sixteen years on the death-rate from Tuberculosis is given below :—

[illegible][illegible][illegible]

The site of Calcutta and its disadvantages.—The site of Calcutta is a dead flat with a slight inclination to the east and as such it does not allow efficient flushing of its underground drainage except during the rains. The drainage system is not sufficiently ventilated. The drainage is contrived for the carriage of sewage and rain water. The pipes percolate and the sewers leak. Of

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the two principal defects, the one contaminates the soil, the other the air. This is a factor which lowers the resisting power of the people. The soil on which the city stands is a recent alluvium. The level of the sub-soil water during the rains sometimes rises to its ground level. The soil is therefore damp and as such favourable for the growth of disease germs. Most of the streets, roads, and lanes in the northern division of the town are narrow and lofty houses standing on either side of them obstruct perflation of air, and the access of the sun. Owing to these structural defects of the city, the utility of the germicidal power of the sunlight is lost to the people.

Residents of Calcutta.—Calcutta is inhabited by various communities of people, each class separated from the other, by its peculiar habits, customs, rites, and mode of living. All these conditions have their relative value in increasing or reducing their susceptibility to diseases. Much has been done by the Corporation of Calcutta to improve the sanitary condition of the city; but more still remains to be done. There are other structural defects of the town which will continue to be a menace to health and a reproach to the sanitary authorities. Besides these structural evils of the town there are other auxiliary defects, which, if allowed to remain in Calcutta, will act as so many factors of the diseases of the respiratory organs, amongst which Phthisis occupies a prominent place. The existence of mills and factories amidst the residential quarters is an evil of no small magnitude. The cause of the increased number of deaths from Phthisis in Ward No. 4 is attributable to this source. I might mention that the smoke nuisance in Calcutta is daily increasing. Every evening long before the sun sets, you will notice a belt of a dark blue coloured smoke forming the boundary of the town, and as soon as the sun goes down the horizon, the girdle or belt, whatever you may be pleased to call it, begins to expand and converts itself into a regular canopy or shamiana, as if intended to guard against the access of pure air. This canopy is made up of smoke, presumably emanating from the chimneys of mills and from furnaces of blacksmiths' shops, etc. The smoke is not merely the product of combustion of coal or fuel, but contains other deleterious substances also, which have their pernicious effect upon the system of man and beast. The smoke does not possess any antiseptic property; but it is an evil which should be forthwith removed. It penetrates into the air passages and lung cells and renders them susceptible to the influence of various kinds of organic diseases. Chronic Bronchitis, Phthisis and other diseases are frequently seen amongst the people who live in the neighbourhood of mills. Soot can be seen in the pocket handkerchiefs after they have been used. The visible mist is nothing else than particles of foreign matters floating in the air and these particles chiefly consist of dust and smoke, horse refuse, ammonia and germs of various kinds. It is necessary for me to explain how it affects health. A man breathing pure air obtains as he requires 2,164 grains of oxygen per hour, whilst an individual breathing bad air gets about 2,000 grains, the deficit is replaced by pernicious matters. If the air is loaded with impurities, the lungs get clogged and their power of absorbing oxygen that is present in the air is diminished.

Factors of Tuberculosis created by the people themselves.—We now come to consider the factors which have been created by the people themselves and for which they alone are to blame. The erection of houses in total disregard of the fundamental rules of hygiene; the collection of refuse inside of the courtyard; close proximity of bed rooms to privies; keeping the gullies and pits choked up with debris of organic matter; throwing excreta of infants and invalids into the already choked up pits; spitting recklessly everywhere and in every part of the house, are things which are detrimental to the interest of health and favourable for the dissemination of Tuberculosis. I have often tried but failed to induce people to believe that there is much risk in collecting refuse inside the house.

Overcrowding.—Of all the known factors conducive to the spread of Tuberculosis, none is so potent as overcrowding. We have got our own rules for the building of new houses, we have our own bye-laws to govern their height; but, to our shame be it said, we have none to regulate the dimension of rooms according to the number of their occupants. Neither have we got any clause regulating the size of openings for ventilation in relation to the size of rooms, nor the height of windows in relation to the height of the rooms. A man who has visited Burra Bazar can write an essay on the subject of overcrowding and its pernicious influence upon health.

It must be clearly understood that a good room in a commodious house has its value upon the health of its occupants. It has been stated before that Moslem women are more susceptible to Tuberculosis than their men and the reason of this is that their purdah system deprives them of the privilege of enjoying fresh air and keeps them constantly cooped up in a room along with their children, whose number is sometimes very great. If a record of the standard of health of the inmates of overcrowded houses be kept, it would invariably show that it is much below par, although the inmates may be well fed and clad. Congested rooms and diseases of the lungs are linked together. The increased rate of mortality in Ward No. 5 is chiefly, if not wholly, due to the construction of its buildings. The houses are lofty and their height generally exceeds four times the width of the street. Being built back to back they do not admit free ventilation. I have often seen and can easily demonstrate by example that the vitiated air of an ill-ventilated house apart from its deleterious effect upon the health of its inmates has got a demoralising effect upon their character.

Besides living in congested rooms Mohamedans have certain customs which favour the spread of Tuberculosis amongst them. They dine together and even confirmed phthisical patients are allowed to partake of food from the same dish. You can estimate the amount of danger that emanates from this awkward practice. In Ward No. 5 most of the houses are old, rickety, and damp, and are inhabited by colonies of people who have migrated into Calcutta for trade or business. The houses built under the new regulation are not even good from a sanitary point of view, and their surroundings are bad. One room of 10' x 8' x 10' is made to accommodate from two to eight inmates; half the floor space is taken up by furniture. People give better attention to the decoration of the room than to their own comfort. A brief description of a room occupied by a consumptive gentleman of means and position in life may not be wholly out of place. The dimensions of his room were 10' x 8' x 10' with two windows and a door. The walls were painted with water colour, the cornices, ceilings and corners were fantastically painted with rich colours. More than two dozen pictures hung in rows on the walls. Six to nine lanterns were placed in the room. A kerosine lamp with a chimney remained lit during the night. One small iron safe on stand and a big wooden chest occupied one side of the room. On another side there was a cot with a miniature charpoy underneath. Just over the wooden chest hung the frocks and sarries of the housewife. The gentleman had six children. This is the pattern of room and decoration usually used by Marwari gentlemen of means.

The poorer class of people occupy rooms with one window and a door to enter; half of the floor is used as a cooking place during the day, utensils are kept in one portion of the room. My friend Major Dyson, the late Sanitary Commissioner of Bengal, whilst inspecting plague-stricken houses came across one,—a room whose dimensions were 12' x 10' x 10' and which had two doors and one window,—in which there were nine inmates, two of whom were laid up with plague and one was suffering from Phthisis. The description of a kutchahut occupied by the poorer class of people with its number of inmates is something horrible like that of the Black Hole of Calcutta. People dread the admission of fresh air during the night, carefully closing windows and door, and they never forget to plug the small openings caused by broken panels of doors and windows with rags and cotton. Those who have advised them to give up this suicidal practice of preventing access of air have incurred the censure of these foolish people. So far I have spoken about the causative factors of the disease. I would now shortly bring to your notice the part played by foodstuffs in propagating and disseminating Tuberculosis. Of all foodstuffs supplied to the people of the city, none is charged so much with introducing Tuberculosis into their families as milk, and I will confine my remarks to it alone.

Milk which is essentially necessary for the support of man in all stages of life has become so dear that people of limited means can ill afford to buy it. Only those who have moderate means can do so. In Calcutta the bulk of the milk supply comes from villages outside the jurisdiction of the corporation and its quality can never be guaranteed. It is often contaminated with germs of disease. That milk brings Tuberculosis is a settled fact and no argument is necessary to establish it. There is no special arrangement for isolating a tubercular cow from the herd and the quality of milk is only judged by the lactometer. In the laboratory of the corporation the analyst conducts bacteriological examinations, and prosecutes the vendors who deal in contaminated milk. Fines and prosecutions have no deterrent effect upon the offenders. The law is on their side. If the vendor chooses to evade punishment he can easily do so by attaching to a doubtful sample a label with the words "mixed milk" written in English. The danger arising from this source can be better imagined than described. The intelligent class of people say that boiling kills all germs and they need not therefore be afraid of milk. We fully appreciate the force of their argument; but what will be the fate of those who take milk in its unboiled state? And the number of such persons is not small. Milk before it is boiled and put into the can is kept for some time in a bowl where flies have free access and these carry the germs of Tuberculosis from the unboiled milk to other foodstuffs kept ready for use. Leaving out of the question the care of a cow with disease of the udder supposed to be due to tubercular bacillus, the milker himself may suffer from Tuberculosis. In a big dairy farm consisting of 150 cows with a pretty large establishment and under competent supervision, out of six milkers one was found to be suffering from Phthisis. We see every day in Calcutta that in the transit of milk from the dairies to the stall the dealers invariably place straws in the receptacles to prevent splashing and in these receptacles float hundreds of dead flies and live flies swarm over them. Vendors who sell prepared foodstuffs may suffer from Phthisis and contaminate them. It has often been found that a consumptive patient after partaking of half the contents of a cup of sago or soojee passes it to the little folks who flock round him. It might be incidentally mentioned that agriculturists, who spend their days and nights in open fields, are less liable to Phthisis. Tubercular diseases of bones, glands, kidneys, peritoneum and intestines are almost unknown to them.

I would now hasten to consider the means by which we can arrest the dissemination of Tuberculosis and ultimately stamp it out altogether from our city. Nothing would answer our purpose better than to radically remove the structural defects of the city, and this we could not possibly do better than by opening out broad streets, by demolishing old rickety houses, by changing the existing regulations for the erection of new houses, and so bringing them in conformity with the rules of hygiene. It is also desirable that the rooms should be made according to the number of inmates they are intended to accommodate; that the size and number of windows should be determined by the dimension of the rooms whose minimum height should be 13 feet. It is also necessary to see that sufficient space be left on all sides of the house to ensure free ventilation. The erection of houses and the materials used in constructing them should be frequently examined by reliable experts and the arrangement of drainage and sewerage be left in the hands of sanitary experts. Special arrangement should be made for the better housing of the poor industrious classes, on whose health depends the well-being of a city. The present method of reclaiming bustee is bad and the process of clearing out bustee without making provision for the ousted people is wrong in principle. Closed huts harbour Tuberculosis and their inmates are soon affected by it. It is hardly necessary to say that these bustee people form the bulk of the menial establishment of respectable houses and if any of the menials contract tubercular disease, there is every likelihood of the germ being carried to the inmates of the house they serve in. When plague broke out in Ward No. 5 the question of cleansing the bustees was pushed forward by the commissioners; but beyond making some spasmodic efforts during panic, nothing of a radical nature was done. The time has come when further delay in carrying out the improvement work will be detrimental to the interests of the people and the city they live in. Objections will be raised by wealthy class of men whose interest will be affected, but private convenience must give way to public good. We have reason to hope that with the opening out of broad streets and demolition of houses unfit for human habitation and the removal of overcrowding further spread of Tuberculosis will be arrested. The importance of a separate hospital for the treatment of Pulmonary Phthisis and other tubercular diseases can never be over-rated. The idea of treating these cases along with other diseases is itself bad. It is unwise and culpable to expose the other inmates of a public charitable hospital to the influence of this terrible disorder of the human frame. It is high time to think of a separate hospital, the number of tubercular cases is fast multiplying and the question of erection of a suitable hospital for the reception of phthisical patients has become imperative. But where are the funds to come from? We cannot reasonably ask Government to take the burden of expense on its own shoulders. We want the hearty co-operation of all intelligent and well-to-do classes of people to create a suitable fund by raising subscriptions from amongst themselves to give immediate effect to this most laudable scheme. The institution must be large enough to accommodate at least five hundred patients and it should stand on a suitable site. There ought to be a sanatorium for the benefit of the middle class of people, who for want of means cannot easily go to a hill station, or to Puri, so that they may derive the benefit of change and open air treatment which is of great value to patients suffering from the incipient stage of Phthisis. There was a proposal to

this effect and a committee was appointed ; but why it did not develop further nobody knows. At the instance of Maharaj Dhiraj of Burdwan a scheme was framed, a suitable site was selected, and plans and estimates of buildings were made out. The idea was, however, finally abandoned. The question may, if possible, be re-opened and steps taken to advance it.

For these reasons I trust that local Governments will take steps to alter the existing laws relating to the building of residential houses and the sale of adulterated foodstuffs and to put a stop to the practice of spitting on the streets by making it penal under the Nuisance Act.

(Signed) KAILAS CHUNDER BOSE, C.I.E., L.M.S.

APPENDIX 22 to No. 4.

EPIDEMIC DROPSY.

In inviting discussion on this humble paper of mine, I might with your permission mention that the recent outbreak of Epidemic Dropsy in and around Calcutta has given an impetus to the minds of professional men to work out its causative factors, and thus to provide themselves with means to ward off its further inroads. In my short paper I have tried to refer in one place to the various hypotheses and their relative value in the causation of the disease. In discussing the paper I need only place before you the points which tend to show that the conclusions hitherto arrived at, are not sufficient, and further investigations are necessary to elucidate the truth. I do not like to take up your valuable time by discussing questions which relate to the nomenclature of the disease, for they are at present involved in complications, but it is reasonably hoped, however, as I have said in my paper, that sooner or later the question will be finally settled, and the two diseases, Epidemic Dropsy and Beri Beri, will be included under one head. Attempts have been made to bring it under the heads of exanthemata, malarious fever, aneoneurotic oedema and other diseases. It has also been suggested that the disease is due to a peculiar condition of the nerves produced by the consumption of polished rice devoid of its phosphorous element. The reasons for our not being able to adopt the views of the workers have been given in my paper. To finally settle the dispute on this point of nomenclature is my apology for inviting further discussions. Regarding the etiology of the disease the learned workers have not yet been able to decide the point. Of all arguments urged in favour of the theory that foodstuffs play a considerable part in the production of Epidemic Dropsy, none has been threshed out with so much force as the plea of consumption of polished or decorticated rice raised by Dr. Craig, the learned specialist appointed by Government to investigate the cause of the disease. The value of the rice theory is greatly depreciated if not altogether lost by the fact of Dr. Craig's not being able to give us a complete list of articles which form the food of the Indians. The allegations of the immunity of the Marwaris from the disease is not correct. They badly suffered from the disease during the epidemic of 1888. In discussing the theory of mustard oil as a causative factor of the disease I might mention that the remarkable coincidence of the discontinuance of the oil and improvement of symptoms should be taken into consideration. To decide the question of the disease being of microbic origin requires further research on the subject, and I do not wish to court discussion on this head but crave permission to mention that a medical gentleman, who, whilst operating upon a patient suffering from Epidemic Dropsy, inoculated himself by puncturing his finger and contracted the disease. I would now beg to discuss the question of the disease being due to changes in the character of the soil produced by the meteorological phenomena attended with heavy rainfall. I submit this argument on the basis of fact mentioned in my paper. I also submit for the consideration of this learned conference that the disease has its own cycle which comes once every ten years, and this I think and I believe I have been able to prove by facts given in my notes. I do not like to encroach upon your time by raising points which have been thoroughly discussed elsewhere.

Epidemic Dropsy or Beri Beri.

In spite of the massive literature on the subject of so-called Epidemic Dropsy, there is still some room left for further discussion on the nosological and etiological aspects of the disease. The profession and the public are alike interested in the finding out of the causative factors of Epidemic Dropsy, which, when it breaks out in an epidemic form, not only exhausts the health and wealth of the sufferers, but permanently makes them invalids. The new distemper, strictly speaking, is an evil of the State, since it seriously tells upon its resources ; a large number of its ministerial officers enter into the sick list, the wage-earning capacity of the industrious classes of its people is reduced to a material extent and poverty stares them in the face. We cannot definitely say when the disease first paid its visit to Calcutta, for the ancient records of Government hospitals and the reports of the Health Officer are silent upon this point. It is also difficult to ascertain whether it first invaded the metropolis of the British Indian Empire and then spread into the suburbs, or if it migrated into Calcutta from other centres of the country. We do not know whether before the year 1877 our predecessors used to return these diseases under the heads of Morbus Bright, Morbus Cordis, or general anasarca. To Dr. Norman Chevers is, however, due the credit of first differentiating the disease from the group of dropsical diseases which abounded in Calcutta, but the honour of throwing additional light on the subject was reserved for Colonel Kenneth McLeod, who in the year 1888 came forward to lift up the veil which had hitherto concealed the foe from our sight and thus caused an impetus which has since stirred up the medical profession to strive hard to know the various phases of the disease. Regarding its nomenclature opinions are divided. One school emphatically holds that it is epidemic dropsy, altogether a new disease, whilst another deliberately maintains that it is the true beri beri of Ceylon, China and Japan. By the united efforts of learned scientists and clinicians we have been able to glean some knowledge of the characteristic features of the disease, and we may now reasonably hope that before long we shall be able to come to a definite conclusion. The question now before us is whether the two schools have made up their differences or are still at variance ; if they are not agreeable to each other, the functions of the Conference should be to settle the difference, for no real good could come

out of such unprofitable disputes. We cannot possibly expect a correct return of the vital statistics of a city, unless we can put its prevailing diseases under their respective heads. The line of demarcation between Epidemic Dropsy and Beri Beri as at present pointed out by the scientists is too narrow, and reasonable fear is entertained that in course of time it will be obliterated and the two diseases will be included under one head. As it is not in the province of this Conference to open discussions on the pathology of a disease, I dare not take up its time by dwelling upon it. It is necessary that to finally settle the question of nosology I must mention a few salient points on which the scientists based their arguments in recommending it for a separate place in the nomenclature of diseases. Colonel K. McLeod, who paid special attention to the study of the various phases of this distemper, speaks from his wide experience that it is a kind of exanthemata. Sir Patrick Manson, the highest authority on tropical diseases, holds the same view, but his description of the character of the rash was different from the description given by Colonel McLeod. Professor Rogers, another keen observer, was, it seems, also led to believe that it was a kind of eruptive fever. The views expressed by these respective authorities, far from being one, tend to complicate matters and throw doubt upon the correctness of their inferences; besides, in the majority of cases the rash was conspicuous by its absence. It is, I believe, universally admitted that an eruptive fever has got a distinct period of incubation, a definite course to run, and has one uniform method of termination; the temperature is always high at the commencement and takes a downward course on the appearance of the rash and gradually comes down to its normal level. Any breach in its characteristic features is an anomaly which it should be the endeavour of the learned observers to remove by further investigation and research. Professor Rogers' observation on the character of the fever in Epidemic Dropsy was not supported by other Indian clinicians. The majority of cases had little or no fever. It was only when the sufferers had other complications the temperature had its upward tendency. The theory of exanthemata, I fear, has not been satisfactorily proved. Next to the theory of exanthemata comes the theory of angeoneurotic oedema preferred by the Honourable Surgeon-General Lukis, and the arguments urged by him in its favour seem to be too strong to be refuted, but before it can be finally adopted the medical profession has a right to enquire whether such extensive swelling of the skin can be effected by such pathological conditions or it may be due to other factors which have not yet been definitely known. Any agent causing vasomotor paresis could be credited with the production of dropsy. In angeoneurotic oedema the swelling is always circumscribed and transitory in character. The circumscribed swollen patches follow no definite course, they come and go away at will. The swelling is well defined by a slightly raised border; one attack is followed by another. The swelling is usually red. Gastric disorders account for the skin changes. Adults are less liable to this complication. Angeoneurotic oedema is often complicated with inflammation of serous membranes, a grave form of evil not rare in cases of Epidemic Dropsy. The majority of the learned workers in the field have laid great emphasis on the existence of patellar reflexes and on the absence of ataxic gait, which, according to their views, are symptoms which at once distinguish this disease from Beri Beri, but close observation will demonstrate the fallacy of the argument. In nearly twenty-five per cent. of cases of Beri Beri we may expect to find these two things, and as I do not like to introduce pathology in discussing the nosology of the disease, I would simply satisfy myself by saying that absence of patellar reflexes and the presence of ataxic gait are often met with in cases of Epidemic Dropsy. I might, with your permission, mention that when the disease broke out amongst the inmates of the Alipore Reformatory, Dr. Pearse, the learned Health Officer of Calcutta, and myself went to the spot to study the phases of the distemper and we were surprised to find that nearly two-thirds of the entire number of patients placed before us had the characteristic gait of Beri Beri and they had no patellar reflex. Colonel Brown, Civil Surgeon of the 24-Parganas, kindly offered us every facility for the study of the character of the disorder. The next point of importance is the theory of Plasmodium Malaria playing a considerable part in the production of the disease, but the result of experiments do not in the slightest degree support it. From arguments adduced, it seems that the learned workers have tried but failed to differentiate Epidemic Dropsy from Beri Beri. I do not know whether patients suffering from actual Beri Beri readily bleed from the gums, nose and rectum. During the recent outbreak of the so-called Epidemic Dropsy the medical practitioners had frequent occasions to treat hæmorrhages from the nose and intestines. Nævoid growths become enlarged and bleed profusely quite spontaneously and on slight pressure, often requiring interference to stop it. The theory of the disease being of microbic origin has been started by some leading men of the profession, but the mere fact of the bacteriologist's inability to discover the special bacilli is no reason to infer that Epidemic Dropsy is not a bacillary disease. To help the Conference with material to work upon this point, I might mention that an Indian surgeon of established reputation whilst removing a bleeding angioma from the person of a patient suffering from Epidemic Dropsy had accidentally punctured his finger with the point of the needle, he took no special notice of it. On the third day he manifested unmistakable symptoms of the disease and is still suffering from its sequel. If we count from the moment of the accident to the development of the symptoms we could roughly estimate the period of incubation to be 48 hours. In connection with the estimation of the incubative stage I might mention the case of a warder who was transferred from Buxar Jail to the Calcutta Reformatory. He lived one night with the sick inmates of the Reformatory and the next morning he showed symptoms of the disease. On analysing the facts collected from the report of the various workers on this subject it is difficult to find out in what characteristics of symptomatology Epidemic Dropsy differs from Beri Beri of China and Japan. It would be unwise to suppress the fact that during the last epidemic we had complications which were never seen before, such as hæmorrhage in the retina, iridochoroiditis, iritis, glaucoma and other diseases of the delicate structures of the eye. These complications were not known to the writers on Beri Beri. I am constrained to say that the name Epidemic Dropsy has been hurriedly coined to meet emergencies; it is a misnomer. It is the Beri Beri which has under peculiar conditions undergone change in type during epidemic. This is my humble view, but it should be the function of the Conference presently to settle the dispute, which, if prolonged, will surely give rise to unprofitable discussion and leave the problem unsolved. Leaving the consideration of the question of nomenclature to the sense of the Conference we now come to consider the causative factors of the disease, and here again we meet with difficulties which the practitioners have not yet been able to tide over nor do we find any ready means to do so. Since 1877 the disease has visited Calcutta and its suburbs altogether four times and each time it has put a new garment upon it. The recent outbreak

of Epidemic Dropsy has caused a regular panic in the minds of the people and the medical practitioners of the town. Various hypotheses have been formulated and the conclusions arrived at, far from being satisfactory, do not compensate for the labour spent on them. The fact of its always preferring the rainy season leads to the suspicion that it may be due to the dampness of the soil, or to some alteration in the normal level of its sub-soil water, or to some special deviation in the barometric pressure or in the thermometric readings. The collection of meteorological notations of the epidemic years and collection of similar reports from other centres of the country where the disease is prevalent, can only help us in coming to a definite conclusion on this point. I have collected the reports of the meteorological observations for the years 1877, 1878, 1879, which covered the period of its first outbreak, the record of the year 1888, the time of its second invasion; of 1901, the period when it paid a flying visit to Calcutta, and of 1908-10, the lengthy duration of its direst outbreak. In studying the report we find that barometric and thermometric readings of the epidemic years were almost uniform. Let me now place before you the amount of rainfall of the epidemic years of Calcutta and of the condition of the sub-soil water and its level and you will find that barometric and thermometric readings of the epidemic years were almost uniform. If we take into serious consideration these meteorological conditions *plus* the character and nature of the sub-soil water of Calcutta and the liability to its contamination by sewage matter, we would find that the causative factors of the disease were imbedded in the soil of Calcutta. As I cannot reasonably include my name with those of the workers in the field of investigation, I cannot possibly do more than simply place before you material, for further consideration. From the meteorological records collected through the kind help of Dr. Pearse and his worthy assistant Dr. Mazumdar, D.P.H., as given below, we may not be wrong in concluding that the meteorological conditions were peculiarly favourable for the outbreak of diseases. It is a matter of regret that I have not been able to collect the meteorological reports of other places where the disease was equally prevalent, and compare them with our own records to enable us to draw final inferences. I must candidly confess that in the absence of a complete report on the subject the value of the theory of the soil playing an active part in the causation of Epidemic Dropsy is greatly reduced; but there is not the slightest shadow of a doubt that it has got its share in the production of the disease. Even if we fail to give our final decision on the point, there is no reason why further investigation on this line should not be carried out. I humbly think and believe that these telluric conditions rendered the soil peculiarly favourable for the reception of the disease, and so long as they are not removed by sanitary improvement or by nature herself the disease will continue to pay its periodical visit. In Calcutta the disease is most prevalent in those wards where the Indians live and where the light of the sun has to struggle to peep into the rooms of the people. Indian gentlemen, who have not much altered their habits but live in the southern division of the town, did not at all suffer from the disease. Instances are not wanting to show that patients made wonderful improvement by going to a drier place and suffered from relapse on their return to Calcutta. The Conference is particularly requested not to lose sight of this important fact. The drainage of Calcutta, which for more reasons than one is not perfect; the lofty houses in Indian quarters and their peculiar construction are undoubtedly points for our serious consideration. Before I dismiss the subject of meteorology and the condition of the soil, I would beg leave to point out that outbreaks of Epidemic Dropsy have invariably followed a heavy rainfall. I would here cite the year 1908. In this year the rainfall was unusually great. Likewise the rainfall during other epidemic years was great. Besides in the year immediately preceding the year of the last epidemic, Calcutta was submerged under water for more than 24 hours and jolly-boats were seen plying in the streets of Calcutta. Next to the question of soil we come to the question of food of the people, on which much greater stress was laid by former workers. As the list of articles which constitute the principal diet of the Indian gentry and the mass has been elaborately given by the various writers on the subject, I need not take up the very valuable time of the Conference by enumerating them here. I would simply make a feeble attempt to fill up the omissions which I doubt not must have been inadvertently made by the writers, most of whom were Europeans and as such had to depend a good deal upon information supplied by their Indian friends. In his very interesting report Major Greig, the learned specialist appointed by Government to investigate into the causative factors of the disease as far as was possible during the short time at his disposal (for he was appointed when the disease had exhausted all its virulence and was on its decline), gives a list in which he inadvertently omits to mention that fish and milk are invariably consumed by the Bengalis. Meat and eggs are also freely used by the middle and wealthy classes of the people who were specially selected as victims of Epidemic Dropsy during the recent epidemic. From time immemorial the majority of the Bengali gentlemen used hand-made *chapatties* for their evening meal. In the most ancient records of the hospitals you will find mention of this habit. The deficiency of phosphorous elements of polished rice was amply compensated by the condiments they used with their staple food. It is not the place to mention what was the chemical composition of the green vegetables most commonly used by the Bengalis. Suffice it to say that the list of articles which constitute the food of the Indians as given by the specialist was not complete. The Mahomedans who had a different scale of diet were not immune from the disease. The Marwaris, though fortunately they escaped during the last epidemic, suffered severely from it during 1888 when the disease was mostly confined to their quarter. There were also few cases amongst them during 1901, when, as I have said before, Epidemic Dropsy only paid a flying visit to Calcutta. It would be not out of place to mention that in a family consisting of five members, four were seriously laid up with the disease, and of them two died. These cases were seen by the then Health Officer of Calcutta. The mere fact of the absence of Epidemic Dropsy amongst the Marwaris during the epidemic of 1909 is no reason to infer that as a class they were exempt from the disease. From the transactions of the Calcutta Medical Society, an institution organised by the efforts of Lieutenant-Colonel McLeod and other learned professors of the Medical College, you would find that in a short paper read by me under the head of Acute Oedema I had to mention amongst other things that Epidemic Dropsy had broken out in Burra Bazar and I had to treat several cases amongst the Marwaris. As it is an important matter, I may be pardoned if I reproduce what I then said at that meeting, and in doing this I must not take more than a couple of minutes of your valuable time.

"Within the short space of two months, I have seen thirty cases in and around Burra Bazar. The peculiarity I have observed in this disease is that the oedema commences from the dorsum of the

feet without exciting any anxiety in the mind of the patient; the swelling gradually rises upwards and attacks the whole limb. It is now that the patient's attention is drawn towards his limbs; his general health fails; his appetite is lost; his urine becomes scanty; there is fever towards evening; insomnia and burning of the hands and feet with constipation of the bowels, and sometimes, though not in every case, vomiting during morning. The duration of the disease is from three weeks to as many months. Bronchitis is a common complication of this disorder, and in some cases diarrhoea or dysentery supervenes during the stage of convalescence.

"Those cases, where diarrhoea sets in early, do well invariably. I have not seen a single case prove fatal by this disease. Only one out of thirty cases died and here pneumonia was the cause of death. People, who live in confined rooms, suffer longer than those who live in well-ventilated houses. This year the disease is confined to Section G of the town of Calcutta. In No. 51, Cotton Street, Burra Bazar, it made its first appearance. In this house a family consisting of six members were all affected with the disease. In No. 16, Mullick Street, a family of four members were next attacked with the disease. The husband first noticed that he could not put on his shoes with the same amount of ease as he used to do before. It made him anxious and in the course of a week his feet assumed double their usual size; he had fever, and was soon confined to his bed. His wife, who attended upon him, was next taken ill and likewise the children. A gentleman who came to visit him got the disease; he occupied a room in Hanspooker Lane. This man had his wife and a child living with him, but fortunately they escaped. In No. 55, Banstolla Street, Sewbux Sereka, a gentleman of considerable wealth and fortune, was next taken ill, his wife and her brother, together with the other members and menial servants, were all confined to bed. The number of patients in the family I counted was more than a dozen. In premises No. 49, Cotton Street, 15 out of 30 members of a mess were laid up with this disorder, and I am told by an inmate of the house that they are still suffering under it."

From the report just placed before you, you would find that the Marwaris whose diet materially differs from the diet of the Bengalis were not exempted from the operation of the disease. Rice has been ungenerously accused of producing the disease. I do not dispute that it is a factor of weakness amongst the race of people who consume it, but that it is not a factor of Epidemic Dropsy can be easily proved by the fact that the people of Bengal have been using rice ever since the creation of the world and they never suffered before from Epidemic Dropsy. Another fact which I might with your permission mention is that the epidemic is now over, but the habit of rice taking is not changed, the quality of rice has not been improved, but the people do not suffer from the disease. If the rice theory is still held by the members of this Conference it will enable them to link the Epidemic Dropsy and Beri Beri together and discontinue to call it by another name; beyond this the rice theory has got no intrinsic value of its own.

Adulterated mustard oil has been held as a factor of the disease and the discussions on this point have not yet been finally closed. I do not think it would be wise to comment upon them at this stage. Dr. Satya Saran Mitra, who has made Epidemic Dropsy a special subject of study and whose excellent papers on the clinical phases of the disease form a complete literature on the subject, has by facts and figures been able to make out a case against mustard oil. He has been well supported by Dr. Satyendra Nath Sen, Assistant Chemical Examiner to the Government of Bengal, and Dr. B. M. Chakraborty, B.A., L.M.S., also of the Chemical Laboratory, Medical College, who have very reasonably kept the discussion open. Rai Bahadur Chooni Lal Bose, Additional Chemical Examiner to the Government of Bengal, was strongly opposed to the theory. Dr. J. N. Dutt, the learned and veteran analyst of the Calcutta Corporation, has shown by facts and figures taken from the analytic work done in his laboratory that much needless anxiety was felt by the people and there was no foundation of truth in the report that mustard oil was adulterated with mineral oil. It is not my intention to bring this controversial point before the learned assembly, for it has been discussed and published in the transactions of the Calcutta Medical Club. I do not criticise the theory of mustard oil, but simply submit for the information of the learned members that the Health Department took the matter up in right earnest at a time when the dealers themselves were convinced of their folly and discontinued mixing mineral oil with mustard oil. I remember a petty dealer saying that he had dearly paid the penalty by introducing this disease into his family and he swore he would never do it again. Whatever may be said against the theory of mustard oil playing a part in the causation of Epidemic Dropsy, it cannot be denied that there was a remarkable coincidence between the discontinuance of the oil and the improvement of systems. Dr. Satyendra Nath Sen has been able to demonstrate it by facts and incidents mentioned in his interesting paper on Epidemic Dropsy. As it is not my intention to write an essay on the etiology of Epidemic Dropsy I need not do more than place the facts before you for discussion in the hope that we may come to a final conclusion. Sir Patrick Manson in his instructive paper on Epidemic Dropsy has said that medical men were not affected by the disease. I wish I could agree with him, but unfortunately the experience of the last epidemic has taught a different lesson. A fairly large number of medical practitioners became victims and one young Assistant Surgeon with a bright future before him was so far run down that he had to retire on pension at the age of 32.

On analysing the arguments placed before the profession by the scientists and clinicians who made Epidemic Dropsy a special subject of study, we find that the workers are not unanimous in their finding and further research is necessary to elucidate the truth. I must candidly confess that I have not been able to form any decided opinion as to the identity of disease; I still hold that it is the Beri Beri of Ceylon, China and Japan and the discrepancies mentioned by the keen observers are mere anomalous phases of the disease. It is, in my humble opinion, a disease of the soil, which under certain meteorological conditions undergoes certain physical changes, which, when they reach a climax, produce the disease. In support of this theory I might mention that the people affected by the disease improved their condition to a material extent by leaving the contaminated area, but were destined to suffer from relapse on their return.

However much we may differ in our views regarding the nomenclature of the disease, we must all admit that we are unanimous in holding that it is an epidemic disease. If we look at the chart as prepared by the learned Health Officer of Calcutta we shall find that it follows the usual course of an epidemic disease; its curve at the beginning is low, and then by leaps and bounds it goes high and

remains so, till the disease has exhausted all its virulence and then slowly and gradually descends with the decline of the epidemic. It has got a definite cycle of its own which comes once in every ten years and this I humbly venture to establish by facts taken from Medical Gazette and other authentic and absolutely reliable sources. The first outbreak of the disease was in 1877-78, the second 1887-88 and 1898-1901, the fourth was in 1908-09. About the first we have got positive evidence from the reports of hospitals; the second has, I trust, been satisfactorily proved from the records of transactions of the Calcutta Medical Society. I regret that I have not been able to show from any published record the existence of Epidemic Dropsy of 1898, but if my memory serves me aright, I remember seeing a few cases amongst the Mahomedans of Amratolla that year. Its existence in 1901 has been amply proved from the writings of the various workers as well as from the Indian Medical Gazette; the fourth and the last was in 1908-9. From the record just placed before the learned assembly it would be found that Epidemic Dropsy has got a cycle of 10 years. As an epidemic disease it is preventable and we may reasonably hope to be able to make it a thing of the past, but to achieve success we require the help of Government and the hearty co-operation of the people. It is true that the sanitarian has not always been able to trace out successfully the source of all epidemic diseases, but he must do everything to arrest their spread by enforcing rigidly the bye-laws which vest him with power to look to the sanitation of the town where it breaks out and to the supply of its foodstuffs. I trust I may be pardoned for once more repeating that Epidemic Dropsy has its close relation with the soil and other meteorological conditions of a town, city or village, where it pays its visit. In Calcutta the epidemic has always broken out in the year in which the amount of rainfall was heavy and the level of the sub-soil water was less than five feet. The drainage system of Calcutta, far from being perfect, has often been found leaky, and the danger arising from this source can could be better imagined than described. To enable the Conference to satisfactorily trace the causative factors of the disease, I have collected the meteorological reports which I beg to append here in the hope that they may be of some use to the learned members of the Conference in ascertaining the etiology of a disease which has proved itself a powerful enemy of a prosperous city. I thank you for your patience and apologise for the meagreness of my paper.

(Signed) KAILAS CHUNDER BOSE, C.I.E., L.M.S.

Sub-soil water.

- (1) Trial well No. 1.
At Ellenborough Course.
Date of collection, 18th May, 1892.
Analysis—

Total solids	...	...	...	...	...	...	...	76.5	per 100,000.
Fixed solids	...	...	...	...	...	...	...	67.5	"
Chlorine	...	...	...	...	...	...	...	4	"
Free NH ₃	...	...	...	...	...	...	...	0.0525	"
Albuminoid NH ₃	...	...	...	...	...	...	...	0.0215	"
- (2) No. 2 well near Dufferin's statue.
Date of collection, 18th May, 1892.
Analysis—

Total solids	...	...	...	...	...	...	...	45	per 100,000.
Fixed solids	...	...	...	...	...	...	...	35	"
Chlorine	...	...	...	...	...	...	...	7.6	"
Free NH ₃	...	...	...	...	...	...	...	0.066	"
Albuminoid NH ₃	...	...	...	...	...	...	...	0.033	"
- (3) Trial well at Canning Street.
Date of collection, 20th July, 1892.
Depth of water from surface, 5 feet.
Depth of water (in the well), 6 feet 9 inches.
Analytical Report—
 Colourless and slightly turbid.
 Odourless alkaline.
 No smell of HS₂.

Total solids	...	...	...	...	...	...	...	47	per 100,000.
Fixed solids	...	...	...	...	...	...	...	34	"
Free NH ₃	...	...	...	...	...	...	...	0.0025	"
Albuminoid NH ₃	...	...	...	...	...	...	...	0.017	"
- (4) Trial well at Emambag Lane.
Depth of water from surface, 7 feet 3 inches.
Temperature of water 28° C.
Date of collection, 20th July, 1892.
Physical character—
 Colourless and slightly opaque.
 Alkaline.
 No smell of HS₂, odourless.

Total solids	...	...	...	...	...	...	...	30	per 100,000.
Fixed solids	...	...	...	...	...	...	...	26	"
Chlorine	...	...	...	...	...	...	...	3.2	"
Free NH ₃	...	...	...	...	...	...	...	0.0105	"
Albuminoid NH ₃	...	...	...	...	...	...	...	0.011	"

Year.	Total N.-E. mon- soon. December to April.	Total S.-W. mon- soon. May to November.	Total.	REMARKS.
1877	?	52.50	?	
1878	6.85	53.55	60.40	
1879	0.72	42.89	43.61	
1880	5.82	63.90	70.72	
1881	5.57	63.80	69.47	
1882	4.68	61.86	66.44	
1883	6.64	43.40	50.04	
1884	4.29	60.86	65.15	
1885	4.11	61.72	65.83	
1886	4.52	61.57	66.09	
1887	5.63	52.44	58.07	
1888	8.80	60.91	69.71	Epidemic year.
1889	4.85	52.59	57.44	
1890	2.13	59.15	61.28	
1891	5.42	41.54	46.96	
1892	1.69	44.98	46.67	
1893	7.02	78.21	85.23	
1894	5.22	43.36	48.58	
1895	2.04	37.42	39.46	
1896	0.25	52.97	53.22	
1897	3.83	54.50	58.33	
1898	1.40	58.12	59.52	
1899	3.03	68.92	71.95	
1900	3.62	83.65	89.27	Epidemic year.
1901	4.76	65.28	70.04	
1902	7.62	54.00	61.62	
1903	3.99	50.81	54.80	
1904	6.33	57.67	64.00	
1905	11.02	58.74	69.76	
1906	11.85	45.84	57.19	
1907	7.06	47.75	54.81	
1908	1.60	79.70	81.30	Epidemic year.
1909	6.05	65.52	71.57	
1910	4.64	51.24	55.88	

From the schedule appended herewith we find that the amount of rainfall in the epidemic year or the year immediately preceding it has been pretty high ; the surface level of Calcutta is 20 feet and the level of its sub-soil water is 15 feet 5 inches. During heavy rains and floods it sometimes becomes 16.5.

(Signed) KAILAS CHUNDER BOSE, *C.I.E., L.M.S.*

APPENDIX 23 to No. 4.

EDUCATION AND PUBLIC HEALTH.

In several of the papers submitted to the Conference stress has, as usual, been laid upon the difficulty of carrying out measures for the improvement of public health in India in face of the apathy and ignorance of the great mass of the people.

It is generally admitted that this ignorance is the great bar to sanitary progress, but no one suggested to the Conference the desirability of measures being adopted for surmounting the difficulty. Apathy and ignorance in the matter of public health are practically one and the same, and therefore the same remedy applies to both, and that remedy manifestly is education. It is hardly fair to blame an absolutely illiterate man for being apathetic and ignorant concerning matters which he has never heard of, or which, if he has heard of, he has been incapable of understanding.

Education concerns the sanitarian probably more than any other administrator in this country, but it is surprising that at the Conference no reference has been made to Mr. Gokhale's Elementary Education Bill, and no stress has been laid upon the urgent necessity for the spread of elementary education. The President alone remarked : "I believe with all my heart in the slow but sure results of education, the forerunner of sanitation."

I believe that the sole reason why the Conference refrained from urging the question of education is that the members are of opinion that the subject had better be left to those directly responsible for education, but it would surely be a stimulus to the Educational Department if the Conference declared, in unmistakable terms, its belief in the dependence of sanitary progress upon education.

Whilst acting as Health Officer of the city of Madras, I was able to demonstrate that the sanitarian may with advantage invade the domain of the educationalist without being regarded as an intruder, and it is to the excellent results likely to accrue from the co-operation of the two departments in Madras city that I would invite attention.

The Madras Corporation is now engaged upon the carrying out of schemes for providing the city with a pure and abundant water-supply and with a complete sewerage system. These schemes have been carefully worked out and definitely accepted, and for the present they give the Medical Officer of Health no concern. He is consequently left free to devote his energies to the dozens of other comparatively minor factors which collectively play such an important part in determining the health of a city. Whilst investigating these problems, one could not help being struck by the fact that the solution of most of them depended upon the co-operation of the people or upon their individual efforts. I made many suggestions to the President, and was almost invariably given permission to carry out my suggestions, but I imagine now that the permission was

often given with a wink of the eye of the more knowing Commissioners. Practically, no appreciable result followed our well-meant efforts, and in the end I was forced to report to the President that, in the present state of ignorance and apathy of the people of Madras, we had reached a deadlock in the matter of efforts to improve the public health, and I offered, as the only possible solution of the problem, the extension of primary education with a view to having it made free and compulsory at the earliest possible date. This suggestion went up to Government in the President's Annual Administration Report, and the Madras Government was pleased to note the suggestion favourably. Having got the ear of the President and the sympathy of Government, the Inspector of Schools for the city of Madras was next approached. He also viewed the proposal favourably, but of course pointed out that before any move was possible in the direction of compulsory education, it was first of all necessary to have the schools which the children were to be compelled to attend.

Matters had now reached the stage when it seemed desirable that the scheme should be placed in the hands of a responsible Committee. The President, the Commissioners and Government were again approached, with the result that Government eventually appointed a Committee to investigate the subject and submit proposals through the Corporation. In the end it was decided and sanctioned that the Corporation should provide for the whole city a sufficient number of school buildings on a model plan, and that Government should pay the teachers, the Corporation being relieved of all other expenditure upon education whilst the building programme is being carried out, and that when sufficient buildings had been erected and teaching staff provided, the question might be raised of making education compulsory for boys to begin with, and in time for girls also.

Matters have now reached the stage that the Corporation has already constructed four excellent schools, their building programme being the construction of at least two schools each year for the next ten years, but as land is now cheaper than it is likely to be in the future a considerable number of additional building sites are being acquired this year.

The schools are intended to be models of construction, object lessons in fact for the children. A walled-in play-ground of sufficient size surrounds each building, permitting of a free circulation of air on all sides. Latrines and bath-rooms occupy a corner of the play-ground. Needless to say, lighting and ventilation receive particular attention. Each school costs from Rs. 6,000 to Rs. 9,000 exclusive of cost of site, and, as building work can be done comparatively cheaply in Madras, it is evident that we are not going in for kutchas or temporary structures.

We are now within measurable distance of the time when elementary education shall be free and compulsory in Madras, and since the Medical Officer of Health has for so far been welcomed in his co-operation with Educational Department, it is not anticipated that any difficulty will arise in persuading the Educational Department to include the elements of hygiene in the curriculum to be taught in these schools.

With the elimination of ignorance and prejudice which must follow upon the spread of education amongst the masses, questions which now seem insoluble to the sanitarian will doubtless solve themselves.

I would suggest to the members of the Conference the placing of education in the forefront of their sanitary programmes. Practically, all the leading municipalities have declared in favour of Mr. Gokhale's Bill, and now is the time to ask them to reduce their professions to practice.

(Signed) T. S. ROSS, *Major, I.M.S.*

No. 5.

Letter from the Government of India to the Secretary of State for India, No. 3, Finance (Salaries, establishments, etc. Medical), dated the 4th January 1912.

We have the honour to refer to the correspondence noted on the margin

Paragraph 5 of the Sanitary Despatch from Lord Minto's Government No. 8, dated the 2nd May 1907. regarding the improvement and extension of the sanitary services in India.

Paragraph 8 of Lord Morley's Despatch No. 118-Rev., dated the 26th July 1907.

2. In submitting our views on the suggestions contained in the memorandum* on plague presented by the Royal College of Physicians in July 1905, we expressed our agreement with the general opinion of local Governments that the sanitary services of this country required development, and we informed Lord Morley that a scheme for such extension was under our consideration. In paragraph 8 of his despatch of 26th July 1907, Your Lordship's predecessor informed us that proposals for extending the general sanitary service by the increased employment of qualified Indians as medical officers of health and sanitary inspectors would within reasonable limits of cost command his cordial support. A copy of the Home Department letter No. 1995—2004, dated the 4th December 1907, in which Lord Minto's Government consulted local Governments on the subject was subsequently forwarded to Sir A. Godley with Sir Herbert Risley's letter No. 414, dated the 19th December 1907. We now enclose for Your Lordship's information a copy of a letter of our Secretary in the Education Department, No. 2094—3001, dated 10th November 1911, which we have recently addressed to local Governments which embodies the conclusions at which we have arrived after considering carefully their

* Issued as Parliamentary Paper, H.C. 169 of 1907.

criticisms and suggestions on the scheme which was forwarded to them in 1907, and their opinions on the recommendations made by the Royal Commission upon Decentralization in paragraphs 377 (V) and 384 of their report regarding the appointment of Provincial Sanitary Commissioners and Deputy Sanitary Commissioners.

3. From paragraph 4 of the above letter it will be seen that certain local Governments have proposed that additional appointments of Deputy Sanitary Commissioners amounting to nine in all should be created and that we have accepted their proposals subject to Your Lordship's sanction. One of these appointments, *viz.*, that of a special Deputy Sanitary Commissioner in Bengal in connection with malaria has already been sanctioned in Lord Morley's despatch No. 86-Rev., dated the 30th September 1910, and we have allowed for two additional appointments for the province of Eastern Bengal and Assam, though for the present it is probable that only one of these two appointments will be created, and in any case this portion of the scheme will require re-adjustment in view of the administrative changes impending. We will submit, in due course, the proposition statements showing the cost of any schemes requiring Your Lordship's sanction when they are received with the final recommendations of the local Governments thereon, but as the consideration of the details of the present scheme has been unavoidably prolonged, we request that sanction may be given, as a tentative measure, to our authorizing the local

Madras	...	...	...	...	2	Governments concerned to create eight additional appointments of Deputy Sanitary Commissioners as shown in the margin. If the new appointments are filled by candidates not belonging to the Indian Medical Service, they will receive the rates of pay proposed in paragraph 6 of our letter, dated the 10th November 1911, the extra expenditure involved being approximately Rs.6,400 a month. But if it is found necessary to appoint Indian Medical Service officers to any of the newly created posts, we have informed the local Governments that the arrangement should not involve an increase of the Indian Medical Service civil cadre.
Bengal	...	...	...	...	2	
United Provinces	...	...	...	...	2	
Eastern Bengal and Assam	...	...	...	...	2	
					—	
					8	
					—	

involved being approximately Rs.6,400 a month. But if it is found necessary to appoint Indian Medical Service officers to any of the newly created posts, we have informed the local Governments that the arrangement should not involve an increase of the Indian Medical Service civil cadre.

4. In the concluding paragraph of our letter we have promised subject to Your Lordship's sanction to assist those local Governments who are prepared to improve their sanitary services on the lines indicated by us but cannot find the money from their provincial revenues, with grants from imperial revenues calculated approximately on the cost of the additional Deputy Sanitary Commissioners at the rates proposed for non-Indian Medical Service men *plus* half the cost of municipal health officers for those towns in which local Governments are of opinion that such officers should, for the present, be appointed. We propose that our subvention should be based on the rates of pay suggested by us in paragraphs 6 and 8 of our letter of the 10th November 1911, and we estimate that the cost will be approximately Rs.2,30,000 per annum though this estimate must necessarily be subject to revision in the light of the detailed schemes which we have asked local Governments to submit. Looking to the importance of the object in view we consider it very necessary to offer this assistance in order to enable the scheme to be brought into force without further delay. The recurring grants which we have already made for sanitation together with any grants from provincial revenues which local Governments have been able to afford are expended to the full in the provision of drainage and water supply, and it is evident from the replies we have received that without further assistance the reorganisation of the present untrained and inefficient staff may be indefinitely postponed. We trust therefore that Your Lordship will approve of the action taken by us.

5. We consider that the agency to be employed for the future development of the sanitary administration in this country should as far as possible be Indian, the direction only being European and of the best class procurable. The proposals we now submit will, we think, prove to be a substantial advance towards this end. Indians will be eligible for all the higher appointments of Deputy Sanitary Commissioners, subject to their possessing a registrable medical qualification and a British diploma in Public Health, qualifications which, for the present, we consider to be indispensable in the interest of sanitation both for these appointments and for those of health officers of the first class in the larger towns. We trust, however, that it will be possible before long to make arrangements for post-graduate study in India, and thus further to facilitate the attainment of the necessary qualifications by Indians in their own country. The appointments of health officers of the second class will be open to Indians, subject to their possessing certain general qualifications supplemented by a course of training in public health to be prescribed by local Governments.

6. We trust that the scheme we now propose will lead to the organisation of an efficient

sanitary staff capable of further expansion in the future, and that by the general training of the people in practical elementary hygiene, the present insanitary conditions which are so prevalent in India, and are the cause of much needless death and suffering, may by degrees be ameliorated.

We have, &c.,
 (Signed) HARDINGE OF PENSHURST.
 " O'M. CREAGH.
 " G. FLEETWOOD WILSON.
 " J. L. JENKINS.
 " R. W. CARLYLE.
 " S. H. BUTLER.
 " S. A. IMAM.
 " W. H. CLARK.

Enclosure 1 in No. 5.

From the Secretary to the Government of India, Nos. 2094-3001, dated 10th November 1911, to the Secretary to the Government of Madras, Local and Municipal Department; the Secretary to the Government of Bombay, General Department; the Secretary to the Government of Bengal, Municipal (Sanitation) Department; the Secretary to the Government of the United Provinces, Sanitation Department; the Secretary to the Government of the Punjab, Home (Medical and Sanitary) Department; the Secretary to the Government of Burma, Medical Department; the Secretary to the Government of Eastern Bengal and Assam, Municipal (Sanitation) Department; the Honourable the Chief Commissioner of the Central Provinces.

I am directed to address $\left\{ \begin{array}{l} \text{the Government of Madras} \\ \text{the Government of Bombay, etc.} \end{array} \right\}$ with reference to the
 you
 correspondence ending with * on the subject of the improvement of the
 sanitary services in India.

2. In the Home Department circular letter Nos. 1995-2004, dated the 4th December 1907, the local Governments were invited to consider the adequacy of the existing sanitary establishments and the desirability of improving them on certain lines. The scheme outlined in that letter has been, on the whole, favourably received, and the Government of India, after considering carefully the criticisms and suggestions which have been laid before them, are now in a position to indicate the general lines on which they desire that local Governments should frame their final schemes.

3. It is necessary, however, to refer, in the first instance, to an important difference of opinion which has been disclosed by the correspondence. It has been maintained that, as the funds available are limited, it is better to give preference to expenditure on water-supply and drainage and the opening up of congested areas. It has been pointed out that municipal finances are not likely to be able, for some time to come, to pay for special sanitary staffs, that Government will be able to assist them, if at all, only to a very small extent, and, in view of this, it has been urged that it is probably inadvisable to insist at present on the appointment of health officers, one of whose functions it will be to recommend costly schemes, for the execution of which funds are not available. With reference to this, I am to remark that the Plague Commission devoted a chapter of the report which they issued in 1901 to the necessity of improving sanitary establishments "with the object of dealing more effectively with outbreaks of plague and other epidemics and with the general sanitation of India." Again, in 1905, the Royal College of Physicians addressed to the Secretary of State a memorandum,† relating chiefly to plague, in which they laid stress on "the inadequacy of the sanitary service in India as at present organised." The Secretary of State, in replying to a deputation from the College, stated that the Government of India were taking steps to improve the sanitary condition of the country and would consider what measures ought to be adopted to make the sanitary

* Madras.—Your letters No. 1002-L., dated the 11th July 1908, and No. 753, dated the 29th September 1909.

Bombay.—Your letter No. 557, dated the 29th January 1909.

Bengal.—Your letter No. 2160—Sanitary, dated the 24th November 1908.

United Provinces.—Home Department telegram No. 795, dated the 27th April 1910.

Punjab.—Your letter No. 2205—S., dated the 24th August 1908.

Burma.—Your letter No. 1020-32-4, dated the 22nd January 1909.

Eastern Bengal and Assam.—Your letter No. 2233—M., dated the 27th March 1909.

Central Provinces.—Your letter No. 403—VI., dated the 31st March 1910.

† Issued as Parliamentary Paper, H.C. 169 of 1907.

service in each province more efficient and to secure the better observance of health regulations. The suggestions of the College of Physicians were referred to local Governments in the Home Department letter Nos. 871-886, dated the 9th May, 1906, and, though many of the proposals made were not approved of, it was generally agreed that the sanitary services required development.

Apart from the recommendations of the Plague Commission and of the Royal College of Physicians, the Government of India consider that there is a strong case for the improvement of the sanitary services. The designers of water and drainage schemes will derive much assistance from trained men with an intimate knowledge of the towns to be served by the schemes and of their inhabitants, and both water and drainage schemes require trained men to look after their working. Also, while improved water-supply and efficient drainage may, to a considerable extent, prevent cholera and reduce the severity of malaria, trained health officers and a sanitary staff are required to deal with plague, small-pox and tuberculosis, infant mortality, the inspection of the food supply, to advise municipalities in regard to building regulations, to endeavour to prevent the erection of insanitary houses and to improve those already in existence, and to put before the people the elementary principles of sanitation.

4. I am now to turn to the specific proposals which were set out in the Home Department letter of December, 1907, and to indicate the lines on which the Government of India consider that an advance should be made towards the improvement of the sanitary services, and their opinions on certain specific proposals made to them by local Governments. The question of the necessity for additional Deputy Sanitary Commissioners, and the method of their recruitment was discussed in paragraph 3 of the Home Department letter of the 4th December, 1907.*

(The Government of $\left\{ \begin{array}{c} \text{Bombay} \\ \text{the Punjab} \\ \text{Burma} \end{array} \right\}$ do(es) not propose the appointment of any additional deputy sanitary commissioners.) $\left\{ \begin{array}{c} \text{Madras} \\ \text{Bengal} \\ \text{The United Provinces} \\ \text{Eastern Bengal and Assam} \end{array} \right\}$ propose(s) that $\left\{ \begin{array}{c} 2 \\ 3 \\ 2 \\ 2 \end{array} \right\}$ additional appointments of deputy sanitary commissioners should be created [†but that only one of these should be filled in the first instance].

The Government of India accept and are prepared to give effect to these proposals where this has already not been done with the sanction of the Secretary of State. $\left\{ \begin{array}{c} \text{The Government of India} \\ \text{They} \end{array} \right\}$ consider that neither the existing appointment(s) nor any which may be created in future $\left\{ \begin{array}{c} \text{neither the existing nor the proposed appointments} \end{array} \right\}$ should be regarded as reserved for officers of the Indian Medical Service.

They take this opportunity for communicating the decision to which they have arrived after considering the opinions of the local Governments on the recommendations made by the Royal Commission upon decentralization in paragraphs 377(v) and 384 of their report regarding the appointment of Provincial Sanitary Commissioners and Deputy Sanitary Commissioners. The Governments of Madras and Bombay already appoint their own Sanitary Commissioners. The Government of India now authorize other local Governments to select their Sanitary Commissioners from officers serving in the Provincial Sanitary Department, provided that no officer of less than fifteen years' service be appointed without the previous sanction of the Government of India; but they will retain the selection in their own hands, when no suitable officer is available in the province, or when the local Government desires to appoint an officer serving in another province. The Government of India further do not consider it desirable that there should be any limitation to the tenure of the office of Provincial Sanitary Commissioners, and they are pleased to cancel the existing orders on the subject contained in the Home Department resolution, No. 4-340-51, dated the 7th June, 1888.

5. With regard to the appointment in future of Deputy Sanitary Commissioners, whether officers of the Indian Medical Service or not, the Government of India consider that their selection should remain with local Governments, subject to the conditions—

- (1) that the candidate holds a British diploma in public health and a registrable medical qualification;

* () To Bombay, the Punjab and Burma.

† { } To Madras, Bengal, the United Provinces and Eastern Bengal and Assam.

‡ [] To Eastern Bengal and Assam.

§ { } To Bombay, the United Provinces, and the Central Provinces.

Other Governments.

(2) that no officer be appointed who is not an accepted candidate for the Sanitary Department ; and

(3) that the Government of India is asked for an officer when the local Government has no candidate available who is qualified and on its accepted list of candidates.

The Government of India have further decided that Indian Medical Service officers officiating as Deputy Sanitary Commissioners, and all such officers, within their first two years of service in the Sanitary Department, shall, as is the case in the Jail Department, have the option of reverting from it at their own request, but that, subject to this qualification and to exceptions in very special cases to be sanctioned by the Government of India, an officer joining the Sanitary Department must serve in it continuously and will not be allowed to use his sanitary appointment as a route to ordinary civil employ. An officer reverting at his own request will ordinarily revert to the duty, military or civil, on which he was employed previous to his appointment to the Sanitary Department.

Home Department letter No. $\frac{57}{58}$ dated the 16th January, 1901.

$\frac{57}{58}$
 $\frac{59}{60}$
 $\frac{61}{62}$
 $\frac{63}{64}$
 $\frac{65}{66}$
 $\frac{67}{68}$
 $\frac{69}{70}$
 $\frac{71}{72}$

If he was in civil employ he will go to the bottom of the provincial list, but if only a candidate for civil employment, he will have to wait his turn for such employment in the usual way. It is desirable that the Sanitary Department should be staffed by

officers who have an aptitude for the work and are willing to devote their whole service to it, and that there should be no indiscriminate transfers between the Medical and Sanitary Departments. It should, however, be understood that service under the Sanitary Department is no bar to selection of suitable officers for employment in the administrative grades. The Government of India will leave to local Governments the option of determining whether any previous term of service should or should not be prescribed as a condition of appointment. If Indian Medical Service officers are appointed to any newly created posts, it will, of course, be understood that the arrangement is not to involve an increase of the Indian Medical Service civil cadre.

6. The Government of India have carefully considered the terms to be offered to Deputy Sanitary Commissioners not belonging to the India Medical Service. They think it desirable that all these new appointments should be non-pensionable, and that the scale of pay should be fixed at rather more than two-thirds of the pay of Indian Medical Service officers in the department. The scale which they think suitable is as follows :—

Years of Service.	Rs.
1—2 (probationary)	500
3—5	600
6—10	700
11—15	800
16 and over... ..	900

the average of which may be taken at Rs. 800 a month. For approved service of over 20 years it may perhaps be desirable to offer a higher rate of remuneration, and it is suggested that Rs. 1,000 would be an appropriate amount up to 25 years, which would ordinarily be the limit of service. The Government of India

hope that $\left\{ \begin{array}{l} \text{the Government of } \frac{\text{Madras}}{\text{Bombay}} \\ \text{etc.} \\ \text{you} \end{array} \right\}$ will be willing to adopt this scale [*if and

when any appointments of Deputy Sanitary Commissioners are created in the Central Provinces]. It is proposed that the officers appointed on this scale should be eligible for leave under the Indian Service leave rules. First appointments should be made on probation for a period of not less than two years, and no officer will receive any increment of pay during the probationary period of his service ; but in the case of men who have rendered approved service as municipal officers of health, the period of probation may be dispensed with at the discretion of local Governments, and the full rate of pay (viz., Rs. 600) allowed. It must be understood that all Deputy Sanitary Commissioners will be debarred from private practice.

7. I am next to refer to the question of the Sanitary Board. The Government of India have decided to leave it to the local Government to determine the constitution of this body. They think, however, that it ought to be constituted definitely with reference to the functions to be assigned to it. If it is to be purely an advisory body, it ought, they consider, to contain the smallest number of persons sufficient to ensure that projects submitted to it will be examined adequately from the points of view of public health, of engineering and of finance and general administration. A typical Sanitary

* [] To Central Provinces.

Board of this sort would consist of a senior officer of the Indian Civil Service, the Sanitary Commissioner and the sanitary engineer, with, if possible, a non-official member to represent Indian opinion. If the Board is to have specific powers of sanction, and is, within certain limits, practically to represent the local Government in matters of sanitation, it will appropriately be larger, but it is, in the Government of India's opinion, most undesirable that a large body of officials, without power to sanction schemes, should be interposed between the local authorities and the provincial Government. (*The

Bengal are

arrangements proposed by the Government of the United Provinces have already been approved by the Government of India.) [†They would commend to the consideration of the Lieutenant-Governor of the United Provinces, a feature of the constitution of the Sanitary Board in Bengal, whereby representative Indians can be co-opted in connection with local schemes in which they are interested.] (§The Government of India have no objection to the arrangements proposed by the Government of Burma being tried, as an experiment, on the understanding that they will be revised, unless they are found to work satisfactorily.) (¶The Government of India hope that the Lieutenant-Governor will reconsider the arrangements he has proposed in the light of these remarks. They are inclined to think that a Board of 10 members, of whom only three or four are likely to have any expert knowledge of sanitation, and whose functions, except in regard to the allotment of funds for works approved by some other authority, appear to be purely advisory, will be of very little use.) (¶¶The Government of India notice that the Sanitary Board in Madras, as at present constituted, includes no one who is necessarily a sanitary expert).

8. The Government of India approve generally of the detailed proposals received from local Governments, as to the towns to be provided with officers of health and the classification of those officers, and will leave it to the discretion of the Governments concerned to appoint a European or an Indian with reference to the special conditions in each town.

They commend to { the consideration of His Excellency the Governor
{ your consideration His Honour the Lieutenant Governor (in Council) a suggestion of the Government of Bengal, that a health officer might suitably be appointed for several small towns jointly, where such an arrangement is possible without friction. They consider that an officer of the 1st class should have a registrable medical qualification, and for the present and until proper arrangements can be made in India for post graduate study, a British diploma in public health. For health officers of the second class the main qualification should be a good general education, supplemented by the personal qualities of tact and energy. The Government of India consider that a medical qualification is desirable but not essential; but that these posts should be open to Indians possessing the general qualifications specified above, and who have obtained a certificate after a course of training in public health, approved by the local Government. They are of opinion that a pay of Rs. 300-20-500 will be suitable for the proposed appointments of health officers of the 1st class and Rs. 150-10-300 for officers of the second class. No doubt in special cases higher pay will be necessary, but the Government of India consider that as a general rule the rates indicated will be sufficient. (§In Burma it may be necessary to give a slightly higher rate of pay to second class officers, but the Governor-General in Council would prefer a uniform rate in all provinces.) They leave it to the discretion of the local Government to determine in the case of both classes of officers of health whether a provincial service should be constituted or whether the appointments should be local, the control which the Government of India consider in any case to be necessary being secured by grants-in-aid. The advantages of a provincial service as providing graded pay and opportunities for promotion are obvious. In the case of grants-in-aid, the observance of regulations laid down by Government should be a condition precedent to the payment of the grant. The Government of India think that the local Government should not make any grant except on conditions which will ensure that only qualified men will be appointed and that they will have reasonable security of tenure. They leave the question of the amount of the grant to be determined in each case by the local { Government }
{ Administration }. The Government of India consider that, in all cases, municipal health officers should be debarred from private practice. (**The proposal that the health officer of Dacca should be the provincial bacteriologist does not commend itself to them. Eastern Bengal and Assam is a large province, little is known of some of the diseases prevalent in it, and the health officer of Dacca can hardly be expected to be expert

* () To Bengal and United Provinces.

§ () To Burma.

¶ () To Madras.

† [] To United Provinces.

‡ () To Punjab.

** () To Eastern Bengal and Assam.

in bacteriology. The Government of India think that it would be much better to appoint a whole-time bacteriologist when funds become available than to place a municipal health officer in charge of the provincial laboratory.)

9. I am now to turn to the question of sanitary inspectors. (*The arrangements in force in Madras have worked satisfactorily, and the Government of India propose to suggest to other local Governments that they should consider whether they cannot adopt similar arrangements, contributing where necessary, to municipal funds a portion of the cost of the sanitary inspectors whose appointment they insist on.) [†I am to forward, for the Governor in Council

the information of His Honour the Lieutenant-Governor (in Council), a copy of your information

papers‡ which show the arrangements in force in regard to the employment of sanitary inspectors by municipalities in the Madras presidency. It will be observed that every municipality in Madras is required to employ one trained inspector at least, a second inspector if the population exceeds 30,000, and at least three inspectors if the population exceeds 50,000. The Government of India think it very desirable that similar arrangements based on such standard of population, income or area as commends itself

to { His Excellency the Governor in Council
His Honour the Lieutenant-Governor (in Council, etc.) } should be introduced, you

wherever possible, in { the Bombay Presidency,
Bengal, etc., etc. } but while recommending the scheme

as a possible goal to be attained, they recognise that the preliminary qualifications to be required from candidates and the course of training they must undergo, are matters to be determined by local Governments. (||In this connection I am to

invite the special attention (of the Government of—) to the scheme§ of training which your

is in force in Madras and which appears to have met with considerable success.) [¶I am also to refer to the Home Department letter No. 555/56, dated 21st March, 1910, forwarding copies of correspondence regarding an arrangement made by the Government of Bombay with the Royal Sanitary Institute for the grant of certificates and to say that any action that may be considered desirable may be undertaken in direct communication with the Director of that Institute.] The Government of India must leave the rates of pay for sanitary inspectors to be determined locally. They doubt the advisability of creating a provincial service for this subordinate staff, but leave this also to the discretion of the local Government. (**They think, however, that the rates suggested by the Government of Burma, viz., Rs. 80, Rs. 100, Rs. 150 and Rs. 200, are somewhat extravagant. These rates are in excess of those recently proposed by Sir Thirkell White for sub-assistant surgeons, who have higher qualifications and have to undergo a longer course of training than sanitary inspectors, and their adoption would probably increase the difficulties which the Government of Burma at present experiences in recruiting for its subordinate medical service. The rates have been proposed mainly on the ground that if lower rates are fixed it will not be possible to obtain men with sufficient education to profit by the course of training suggested by Colonel King. The Government of India think that this course is unnecessarily elaborate, and would invite the special attention of the Government of Burma to the syllabus of training prescribed for sanitary inspectors in Madras. They think that the Government of Burma would be well advised to restrict its course of training, for the present at any rate, to the standard which the Government of Madras have found to be sufficient. I am further to suggest that the provisions proposed for rural areas should, for the present, be omitted from the scheme, and that every endeavour should be made to reduce to a minimum the proposed expenditure on buildings and on lectures. I am to add that the Government of India, though they hope that the Government of Burma will find it possible to adopt the arrangements in force in the Madras presidency, will be prepared to consider revised proposals for a provincial service of sanitary inspectors in Burma, if, on reconsideration of the whole question, Sir Harvey Adamson agrees with Sir Thirkell White that, in the circumstances of the province, a provincial service of sanitary inspectors is necessary).]

10. ††The Government of India understand with reference to correspondence ending with Mr. Robertson's letter No. 275, dated the 7th February, 1910, that the Government

* () To Madras.

† Not to Madras.

‡ Paragraph 7 of the Madras Government's letter No. 1002-L., dated the 11th July, 1908, and Annexure I to that letter.

§ Copy enclosed.

|| Not to Bombay.

¶ Not to Madras and Bombay.

** To Burma.

†† To Bombay.

of Bombay have already made arrangements for the training of sanitary inspectors, and that these arrangements can be developed, as and when this becomes necessary, so as to meet all the needs of the presidency.

¶¶. The Government of India consider that power should be vested in a local Government to require a municipality to appoint a health officer or sanitary overseer, and to veto the appointment of an unfit person. I am to ask that any amendment of the Municipal Act that may be necessary for this end may be considered.

¶½. I am finally to ask that when this letter has been considered, proposition statements, showing the cost of any schemes, requiring under financial rules the sanction of the Government of India or of the Secretary of State, which the Governor in Council

His Honour the Lieutenant-Governor (in Council, &c.) } may finally decide to recom-
you

mend, may be prepared and forwarded, with a statement of his final recommendations, your to the Government of India.

¶¾. In view of the importance which the Government of India attach to the object aimed at, they will be prepared, subject to the sanction of the Secretary of State, to help local Governments who cannot find the money from Provincial revenues, with a subsidy calculated approximately on the cost of the additional Deputy Sanitary Commissioners at the rates proposed for non-Indian Medical Service men *plus* half the cost of the municipal health officers for the towns in which, as indicated in their detailed proposals, local Governments consider that such officers should be appointed, the cost being based on the rates of pay suggested in paragraph 8 of this letter. The Government of India hope that the balance required can then be provided without difficulty by the local Governments and

the municipalities concerned ; and that { the Governor in Council
His Honour the Lieutenant-Governor (in Council)
you

will also be able to give assistance to such municipal bodies as require it in the organisation of the subordinate staff of sanitary inspectors.

Enclosure 2 in No. 5.

Letter from the Secretary to the Government of Madras, Local and Municipal Department, to the Secretary to the Government of India, Home Department, No. 1002-L., dated 11th July 1908.

I am directed to acknowledge the receipt of Sir Herbert Risley's letter No. 1995, dated 4th December 1907, on the subject of the improvement of the sanitary services in India and the development of the present establishment on lines which will bring it abreast of modern requirements.

2. In that letter it was pointed out that the time had come when an endeavour could be made towards a complete reorganisation of the Sanitary Department, and the Government of India accordingly offered certain suggestions regarding the nature and direction of the advance which should now be made. The views of this Government were invited on these suggestions which relate mainly to the following questions :—

- (1) The employment of additional Deputy Sanitary Commissioners and the conditions of their recruitment.
- (2) The constitution and powers of the Sanitary Board.
- (3) The employment of Health officers for towns and their qualifications.
- (4) The employment of Sanitary Inspectors for supervising conservancy establishments in towns and their qualifications and pay.
- (5) The nature of the service of the Health Officers and Sanitary Inspectors, *i.e.*, whether they should be formed into a regular Provincial Sanitary Service or whether each local authority should recruit its own staff independently.

3. His Excellency the Governor in Council has given his careful consideration to these questions, and I am directed to convey his views thereon in the following paragraphs.

4. First, with regard to the employment of additional Deputy Sanitary Commissioners, I am to state that there is at present only one Deputy Sanitary Commissioner in this Presidency. This officer is also the Inspector of Vaccination. His Excellency in Council agrees with the Government of India in considering that additional officers of this class are needed in the interests of sanitation, and accordingly proposes to employ

two additional Deputy Sanitary Commissioners. It is at present impossible for the Sanitary Commissioner to visit every important town in the Presidency in the course of the year and his inspection of minor towns and rural villages is necessarily still more restricted. Under the present proposals the Presidency will be divided into three circles; one Deputy Sanitary Commissioner will be posted to each circle and will be responsible also for the exercise of general supervision in regard to vaccination equally with other matters connected with sanitation in his circle.

5. The Sanitary Board as at present constituted in this Presidency is, as the Government of India observe, only an advisory body approving or disapproving plans and estimates for sanitary works coming before it. But in expressing its views on sanitary schemes the Board invariably obtains the opinions of the Sanitary Commissioner and the Sanitary Engineer whom the Government of India desire to include in the Board. The criticisms or suggestions of these officers are always before the Government when they pass their final orders on the schemes. His Excellency the Governor in Council does not therefore see that any material advantage would be derived from the substitution of these officers on the Board for the Chief Engineer and the Surgeon-General; nor does he consider that any good will be gained by adding one or two non-official Indian members to the Board which already contains all the expert officers who are actually needed. As the present system under which the Board discharges its functions merely as a consultative body is found to work satisfactorily, this Government are not in favour either of altering its constitution or of investing it with any executive powers. So long as the Board continues to be merely advisory, and in the opinion of this Government it should be so, the introduction of Indian element into the Board seems to be unnecessary. Such a course will not in any way serve to promote self-government. An increase in the number of members is also likely to render the Board unwieldy without any corresponding benefit and thereby to retard its work. The Madras Government have had already under consideration the question as to whether the Sanitary Board cannot be made more elastic, and greater powers of initiation and execution given to local bodies in respect of minor sanitary schemes without reference to the Board or Sanitary Engineer than exists at present.

6. With reference to the question of employing Health officers in towns and the qualifications to be required of them, I am to express the concurrence of this Government with the Government of India in their views set forth in paragraphs 5 to 7 of Sir Herbert Risley's letter under reply as to the desirability of employing in all important and populous towns special Health officers who have undergone a special course of sanitary training. Health officers are already employed in this Presidency by the Corporation of Madras and by the Madura Municipality. His Excellency in Council recognises the necessity for appointing a Health officer in the equally important and populous town of Trichinopoly and perhaps in eight other towns which have a population of over 50,000. But in the case of Trichinopoly Municipality as well as in other smaller towns the question is beset with financial difficulties. In the existing state of the finances of the municipalities concerned and in view of the many pressing schemes of a sanitary nature, such as the introduction of a good water-supply, a system of comprehensive drainage and the opening up of congested areas which are now under consideration by some or all of these Councils, it is probably not advisable to spend money at present in appointing Health officers whose chief function will be to recommend to the local bodies concerned the execution of schemes for sanitary improvement for the execution of which funds are not at present available. As regards rural areas the services of special Sanitary Assistants of the rank of Assistant Surgeons have been placed at the disposal of District Boards in seven districts in the Presidency. It has not, however, been possible so far to frame any accurate judgment as to the results of their work which has in some cases called for unfavourable comment, and the Government do not consider it desirable at present to insist upon the appointment of these officers in the case of other local bodies without their ready concurrence. There also appears to be some dissatisfaction amongst this class of officers who consider that they are inadequately remunerated as compared with their fellows in the ordinary medical line. His Excellency the Governor in Council fully concurs with the opinion expressed in paragraph 8 of the Government of India's letter under reply as to the desirability of disallowing these Health officers, whether in municipalities or in rural areas, to undertake private practice. It will be necessary to compensate them by special allowances for the loss of such practice.

7. As the Government of India observe, there exists already in this Presidency a body of trained Sanitary Inspectors for supervising the conservancy arrangements in municipalities and in few important union towns. A short summary of the orders and rules of this Government regarding their training, employment and remuneration is

appended to this letter, and a copy of the pamphlet which has been issued by the Sanitary Commissioner with this Government and which gives detailed information regarding the education and discipline of these Sanitary Inspectors is also forwarded for the information of the Government of India. It may be seen from the summary in the appendix that the pay of these men varies from Rs. 20 to Rs. 70, and that the number of trained Sanitary Inspectors and Assistant Sanitary Inspectors is considerably in excess of the number of permanent appointments available for them. The training given to them appears to be sufficient for all ordinary sanitary requirements which do not call for investigation by an expert engineering staff, and His Excellency in Council is of the opinion that they turn out a considerable amount of valuable work in towns where they are employed. As, however, the present rate of pay offered to them appears to be sufficiently attractive and as local bodies cannot afford to employ a more highly paid establishment, the increased scale of salaries rising from Rs. 50 to Rs. 150 suggested by the Government of India for these Sanitary Inspectors does not seem to be suitable for adoption in this Presidency.

8. Turning to the last question, *i.e.*, that of creating a Provincial Sanitary Service for Health Officers and Sanitary Inspectors, I am directed to state that as regards Sanitary Inspectors the proposal involves a degree of interference with local bodies which is quite foreign to the system of Local Self-Government as it at present exists in this Presidency. The Sanitary Inspectors are employed and paid by local bodies out of Local Funds and the necessity for leaving the control and appointment of these officers to the local authority concerned cannot, in the circumstances, be too strongly emphasized. One of the main objections urged against the system of the recruitment of its own staff by each local authority is the insecurity of tenure of appointments under these local bodies. Sanitary Inspectors are largely employed only in municipalities. The rules laid down by this Government for the punishment and dismissal of servants in the service of municipalities afford these officers ample protection from high-handed treatment by the Chairman or individual members of the Municipal Council, as they can in all cases of dismissal appeal to the Council or the Government according as their pay is less or more than Rs. 50, while the recent adoption of the Provident Fund system by a large proportion of District Municipalities in this Presidency will, the Government trust, make municipal service more attractive and also induce trained and qualified Sanitary Inspectors to seek employment under those bodies. In order, on the other hand, to keep the Sanitary Inspectors under strict discipline during their service under local bodies, the Sanitary Commissioner maintains in his office a register of all qualified Inspectors in which every action affecting their character during their service is noted, and all local bodies before employing an Inspector are required to consult the Sanitary Commissioner as to his character and conduct. This officer has also the power of cancelling or suspending the certificate of any Sanitary Inspector for gross misdemeanour. Under the system obtaining in this Presidency the position of Sanitary Inspectors under local bodies is thus fairly secure, while, at the same time, it leaves a sufficient margin of control in the hands of the Sanitary Commissioner. As regards Sanitary Inspectors, His Excellency the Governor in Council, therefore, does not at present advise any change in this system and is consequently unable to accept the proposal to form a separate Provincial Sanitary Service for this class of officers serving under different local bodies financially independent of each other. As regards the class of Health officers, however, who require special training, His Excellency in Council, while considering that a separate and distinct service for these officers is unnecessary, will be prepared, as in the case of officers of this class who are already employed under local bodies, to provide such additional officers as may be deemed necessary by increasing the cadre of the Civil Assistant Surgeons to such extent as may from time to time be required. These officers will, as in the case of medical subordinates at present lent to District Municipalities, be posted by the Surgeon-General but will be under the immediate control and subject to the orders of the President or Chairman of the local bodies as the case may be. Their pay and allowances will be disbursed from Local Funds direct, but they will be Government servants holding pensionable appointments whose services are being lent to the local body concerned.

As has been already observed, it may be desirable to render this class of service more attractive and to compensate such Health officers for the loss to which they are subjected by the deprivation of private practice by the grant of substantial allowances. While therefore the immediate control of such officers will rest with the local body to which their services are lent and while they are paid directly from the funds of those bodies, the Government will be prepared to contribute, as far as funds permit, by way of subsidy, to the funds of those local bodies in order to enable them to bear the extra expense involved by the appointment of such officers. *

9. In paragraph 12 of the letter under reply, the Government of India allude to the question of sanitation in rural areas and suggest in passing that Assistant Health officers are probably necessary in some districts. I am directed to state, for the information of His Excellency the Governor-General in Council, that this Government have recently recommended the District Boards the appointment of Sanitary Assistants to District Medical and Sanitary officers for the supervision of sanitation and vaccination in the rural areas in the district. This subject has been referred to incidentally in paragraph 6 *supra*. Seven District Boards have so far employed these Sanitary Assistants who are recruited from Civil Assistant Surgeons in the Medical Department. These are therefore Government servants lent to Local Boards. A copy of the rules regulating their duties with the form for the programme and diary to be submitted by these officers is printed as Annexure II to this letter.

10. A suggestion has been made by the Hon'ble Mr. Krishnaswami Aiyar that the Government should call into existence a special Sanitary Association largely composed of non-officials whose duty it will be to appoint itinerant sanitary preachers for the purpose of inculcating, mainly with reference to the principles of the Hindu and Muhammadan religions, the observance of strict sanitary rules in rural areas. This question is one entirely independent of that relating to the improvement of the sanitary service, but His Excellency the Governor in Council does not consider that any material results are likely to ensue by the grant of a subvention to a private association for such a purpose.

11. In conclusion I am to say that His Excellency the Governor in Council, while considering that the appointment of two additional Deputy Sanitary Commissioners is necessary to help local bodies with their advice and that much useful work can be done by the appointment of special Health officers in the larger towns, is of opinion that the creation of a separate Provincial Sanitary Service in this Presidency to carry on sanitary work independent of the control of local bodies—from whose funds mainly the ordinary subordinate sanitary staff is paid and ordinary works of sanitary improvements are carried out—would be undesirable as being incapable of adaptation to the condition of Local Self-Government in this Presidency, where, it is believed, the expenditure from Local Funds on sanitation is considerably in excess of that in other provinces.

12. A proposition statement to give effect to the proposal to appoint two additional Deputy Sanitary Commissioners will be separately submitted to the Government of India for sanction.

ANNEXURE I.

SUMMARY OF ORDERS AND RULES RELATING TO THE TRAINING AND EMPLOYMENT OF SANITARY INSPECTORS BY THE LOCAL BODIES IN THE MADRAS PRESIDENCY.

Under the rules issued with G.O. No. 1131-L., dated 11th September 1903, as modified by G.O. No. 278-L., dated 8th March 1906—

no person shall from and after the 1st January 1906 be appointed to the post of Assistant Sanitary Inspector unless he possesses the following qualifications, namely—

- (1) A certificate from the Principal of the Medical College that he has undergone the prescribed course in physiology, hygiene and bacteriological demonstrations.
- (2) A certificate from the Commissioner for Government Examinations that he has passed the Intermediate Technical examination in physiology and hygiene, or a similar special examination in the same subjects.

NOTE.—The course required by clause (1) must precede the examination prescribed by clause (2).

No person shall be appointed to the post of Sanitary Inspector unless he possesses the qualifications necessary for the post of assistant sanitary inspector and the following additional qualifications, namely—

- (1) Either a certificate of having successfully passed the Engineer Subordinate class at the College of Engineering.
- (2) Or
 - (a) a certificate from the Sanitary Engineer or the Assistant Sanitary Engineer that he has undergone the prescribed course in Minor Sanitary Engineering; and
 - (b) a certificate from the Commissioner for Government Examinations that he has passed a special examination in minor sanitary engineering.

NOTE.—The course required by clause (2) (a) must precede the examination prescribed by clause (2) (b).

Admission to the Medical College is restricted to those who have passed the Matriculation examination of the Madras University and the course in the College extends from July to December and consists of theoretical and practical training. The course in Minor Sanitary Engineering is taken at the King Institute of Preventive Medicine, Guindy, and extends from January to May in each year.

2. The above rules do not apply to any certificated Sanitary Inspector who on the 31st December 1905 held a permanent post as Sanitary Inspector or as Assistant Sanitary Inspector or as Superintendent of a Vaccine Depot under any Local body or as Deputy Inspector of Vaccination in the Madras Vaccination Department or who can prove by extracts from the register of certificated Sanitary Inspectors maintained in the office of the Sanitary Commissioner that he had within two years

previous to that date served any Local Body as certificated Sanitary Inspector or certificated Assistant Sanitary Inspector on temporary plague or cholera duty and that his conduct during that period had been satisfactory.

3. Under an additional rule made in 1907, Assistant Sanitary Inspectors are required to produce also a certificate from the Sanitary Commissioner that he can cycle, while a Sanitary Inspector has to produce a certificate from the same officer (Sanitary Commissioner) that he can both ride and cycle.

4. The minimum pay recommended by Government for adoption for these officers is given below :—

For towns with a population below 20,000 ...	Rs. 25 to Rs. 30 in Northern Circars and Ceded Districts, and Rs. 20 to Rs. 25 elsewhere.
For towns of 20,000—30,000 inhabitants ...	Rs. 30—1—40.
" " 30,000—40,000 " ...	Rs. 40—1—50.
" " 40,000—60,000 " ...	Rs. 50—1—60.
" " 60,000 inhabitants and upwards...	Rs. 60—1—70.
Assistant Sanitary Inspectors in subordinate charge or a part of a town.	Rs. 25 to Rs. 30 or Rs. 20 to Rs. 25 according as it is in the Northern Circars and Ceded Districts or elsewhere.
Sanitary Inspectors in rural areas employed on fairs, festivals or epidemics.	Rs. 30—1—40.

5. Every Municipal Council is required to employ at least one trained Sanitary Inspector, while Municipalities with a population exceeding 30,000 inhabitants employ not less than two trained Sanitary Inspectors and those with a population exceeding 50,000 inhabitants not less than three trained Sanitary Inspectors. The employment of Sanitary Inspectors by District Boards in rural areas is generally limited to the number required for the supervision of sanitary arrangements at festivals and fairs or on the occasion of epidemics. Their employment in a few important unions has also been permitted.

6. Appointment of these officers vests with the Chairmen of Municipal Councils and Presidents of District Boards who are required to make their selection from the list of duly qualified candidates without employment, which is maintained by the Sanitary Commissioner. Sanitary Inspectors are also largely employed on plague prevention and disinfection duty, immediately under the orders of the District Collector, the cost of these establishments being charged to the local body within the local jurisdiction of which they are employed.

7. In Municipalities, Sanitary Inspectors must maintain a diary in which all sanitary reports and recommendations shall be written daily. This diary shall be submitted daily to the Chairman, who will record in the margin his orders or the action he has taken thereon, and it shall be liable to inspection by the Collector, the Divisional Officer, the District Medical and Sanitary Officer, and by the Sanitary Commissioner and his Deputy. When the local medical officer is of or above the rank of Assistant Surgeon, it shall be submitted to him for inspection not less than once weekly. When for any purpose a separate and special report from a Sanitary Inspector is required by the Chairman and is not entered in the diary, a précis of the report and order passed thereon by the Chairman shall be entered in due chronological sequence in the diary by the Sanitary Inspector.

8. A register of Sanitary Inspectors is maintained in the Sanitary Commissioner's office in which anything against their character during their service is entered and when local bodies, either District Boards or Municipalities, employ an Inspector, previous to appointment, they are required to consult the Sanitary Commissioner as to the character of the candidate. The Sanitary Commissioner has the power of suspending or cancelling the certificate of any Sanitary Inspector in the case of misdemeanour.

9. To enable Sanitary Inspectors in Municipalities to keep up their study and be abreast of the times, Government have authorised these bodies to purchase sanitary literature for the use of these subordinates, and to ensure that they maintain their professional knowledge they are examined quarterly by the District Medical and Sanitary Officer and the results of the examination communicated to the Sanitary Commissioner.

10. The total number of qualified Sanitary Inspectors borne at present on the list maintained in the Sanitary Commissioner's office is 583. Of these only 198 men are actually employed as Sanitary or Assistant Sanitary Inspectors under local bodies and 47 others are on temporary plague duty.

ANNEXURE II.

RULES REGULATING THE DUTIES OF SANITARY ASSISTANTS TO DISTRICT MEDICAL AND SANITARY OFFICERS.

1. The Sanitary Assistant to the District Medical and Sanitary Officer shall be on duty in places other than his head-quarters not less than 21 days in each month; but, consistently with the correct performance of his duties and public interests in reference to epidemic diseases, gazetted holidays may be accepted as part of the 21 days so spent.

2. The Sanitary Assistant shall submit by the 7th of each month programmes showing localities that he intends to inspect during the following month, through the District Medical and Sanitary Officer, to the President, District Board. The District Medical and Sanitary Officer shall make his recommendations with reference to this programme to the President, District Board, and the latter officer shall issue such orders thereon as he thinks fit through the District Medical and Sanitary Officer.

3. In the emergency of an epidemic, the District Medical and Sanitary Officer may require his Sanitary Assistant to deviate from an approved programme, subject to his reporting to the President, District Board, his reasons for requiring such deviations and the cause of urgency.

4. Programmes should be so arranged that, as far as feasible, the entire district may be inspected by the Sanitary Assistant not less than once in each year.

5. The Sanitary Assistant shall make himself acquainted by personal enquiry and investigation with all conditions affecting or likely to affect the health of the populations of the area under his charge. When he inspects a union or a village with over 2,000 inhabitants he shall prepare and submit a written report thereon in the prescribed form, embodying his recommendations for needed improvements, the recommendations being made with due regard to the financial condition of the local bodies concerned. The report shall be sent to the President, District Board, in duplicate, through the District Medical and Sanitary Officer. The President, District Board, will forward one copy of the report to the Sanitary Commissioner who will return the same with his remarks. In the case of villages with less than 2,000 inhabitants the Sanitary Assistant shall embody his recommendations in the remarks column of the diary, and the President, District Board, shall take such action upon the diary as may seem necessary. Reports on unions and important villages should, however, as a rule be submitted by the District Medical and Sanitary Officer; the Sanitary Assistants should ordinarily devote their attention mainly to the inspection of the outlying villages which are not likely to be visited by the District Medical and Sanitary Officer, and to the examination of the condition of vital statistics and vaccination and the investigation of epidemics and the like.

6. A copy of the monthly vital statistical returns which now pass direct from the office of the Collector to the Sanitary Commissioner shall be communicated for information and return to the Sanitary Assistant; and he shall offer to the President, District Board, through the District Medical and Sanitary Officer, such observations thereon as he may think fit.

7. Copies of daily cholera, small-pox and plague reports should be sent by the authorities concerned direct to the Sanitary Assistant, as well as to the District Medical and Sanitary Officer and the Sanitary Commissioner as usual.

8. Whenever, by persual of statistical returns or otherwise, the Sanitary Assistant has reason to consider the mortality in any local area to be abnormal or that any local area is threatened with epidemic disease, he shall bring the fact promptly to the notice of the President, District Board, through the District Medical and Sanitary Officer, with his recommendations on the subject and shall at the same time furnish a duplicate of his report to the Sanitary Commissioner.

9. The Sanitary Assistant during his tours on duty shall do his best to gather information as to disease causation, and especially to ascertain facts that may be of value in parasitology or bacteriology in respect of the diseases of animals and man. On such subjects he should correspond freely with the Superintendent, King Institute, direct, and he will follow any directions that officer may give him as to methods of obtaining information and gathering specimens for examination by him. The decisions of the Superintendent, King Institute, on such subjects will be communicated through the Sanitary Commissioner, except when delay is likely to be inimical to the public interests, when a copy of the communication will be sent to the Sanitary Commissioner. The Sanitary Assistant will keep the District Medical and Sanitary Officer fully informed of any enquiries thus set on foot and of the results secured.

10. Every Sanitary Inspector employed in Local Fund areas where there are Sanitary Assistants shall maintain a diary in a form prescribed by the Sanitary Commissioner and approved by Government. This diary shall be open to inspection by the Sanitary Assistant during his inspection, or at any time he may think it necessary to call for it. The Sanitary Assistant shall forward any recommendations founded upon information so gained, through the District Medical and Sanitary Officer, to the local authorities concerned; but if his recommendations are of an urgent nature, they may be tendered direct, and the District Medical and Sanitary Officer supplied with a copy of his recommendations.

11. It shall be the duty of the Sanitary Assistant to assemble all sanitary staff and to examine conservancy plant in localities inspected by him, after giving due notice to the local authorities concerned, and he shall report in the manner stated in rule (5) as to the sufficiency, efficiency and economy of menial staffs and of plant employed.

12. The District Medical and Sanitary Officer shall, ordinarily, have attached to him an efficient overseer-draftsman paid by the District Board capable of making estimates, levelling and drawing plans for minor sanitary works; and when the District Medical and Sanitary Officer is not on tour, this Officer shall be attached to the Sanitary Assistant for duty. He should be employed for preparing plans and estimates of any minor sanitary works or in securing rough data to support proposals for important works. In particular, with the aid of this subordinate, the Sanitary Assistant will seek and make practical suggestions for minor sanitary works that are likely to prove of benefit for the eradication of malarial fevers, and for other simple sanitary improvements, such as the diversion of surface washings of inhabited areas from drinking water tanks, the urgent repair of wells where the sanitary safety of water is involved, the making of simple improvements for conservancy and the disposal of sewage and the like.

13. Inspection of municipalities shall be effected only at the special request of the District Medical and Sanitary Officer, but it shall be the duty of the Sanitary Assistant to do all in his power to warn Municipal Chairmen as to the proximity of any dangerous epidemic disease, or conditions observed in rural areas surrounding the town that may endanger its water supply or otherwise threaten the health of the inhabitants. Copies of such communications should be promptly sent to the District Medical and Sanitary Officer.

14. The District Medical and Sanitary Officer shall not assign to the Sanitary Assistant any other than strictly sanitary duty, except with the express permission of the President.

15. The Sanitary Assistant may be employed under the special orders of the District Medical and Sanitary Officer in carrying out inoculation with any vaccine or serum; but the use of anti-small-pox vaccine would be required of him only in an emergency, and in the absence of a vaccinator.

16. The Sanitary Assistant shall make recommendations to the President of the District or Taluk Board concerned through the District Medical and Sanitary Officer as to the provision in any special locality of disinfectants and sanitary equipment, and during his inspection should satisfy himself as to the sufficiency and condition of such equipment as may be ordered to be supplied.

17. The Sanitary Assistant shall systematically scrutinise the birth and death registers of all towns and villages inspected by him. He shall take particular care to explain to those responsible the object of securing correct statistics, and attempt to aid them in classifying mortality according to

causation, and in systematising their efforts generally. All feasible methods of check, such as enquiry from the inhabitants, public servants, and examination of grave-yards, should be made and the result should be reported in the sanitary inspection forms supplied by the Sanitary Commissioner referred to in rule (5).

18. The Sanitary Assistant shall examine the village sanitary inspection books, make suitable entries therein, and call attention to defects in their maintenance.

19. In his attitude towards the population, it is important that the Sanitary Assistant should remember that changes in sanitary conditions effected by persuading people of their necessity is the true rôle of the sanitarian, and that he should not recommend a resort to legal compulsion without the most obvious necessity. He must during inspection attempt to exchange views with the people in a friendly manner, and by fair argument and demonstration to show that it is worth while following sanitary directions. In this respect, the assembly of the people on the evening following an inspection of a village and talking over with them the conditions found would be of much utility. For such purposes the District Board should furnish annually, if funds permit, a grant sufficient to cover the cost of diagrams, models, magic lantern with slides and the like.

20. The Sanitary Assistant may attend any meeting of a Taluk Board or Union Panchayat within the district to which he is attached, at which he believes any sanitary matter is about to be discussed, and he may state his views, if the president of the Taluk Board or Chairman of the Union Panchayat permit him to do so ; but he shall have no right to vote.

21. In connection with vaccination, the Sanitary Assistant shall make himself acquainted with all factors likely to restrain its correct and satisfactory working, and endeavour to persuade all persons showing unwillingness to accept it. The importance of re-vaccination of adults should be constantly brought to notice.

22. The Sanitary Assistant shall inspect all local vaccination registers and test their accuracy.

23. The extent and quality of vaccination shall be systematically inspected and reported upon in every area visited by the Sanitary Assistant and the results stated in the form referred to in rule (5).

24. Instances of careless modes of operation or of protecting vaccine from heat and septic factors by vaccinators should be promptly reported to the Superintendent, King Institute.

25. The Sanitary Assistant may call for and peruse any official register or document maintained by any vaccinator or deputy inspector of vaccination. He shall bring to the notice of the President, District Board, or Sanitary Commissioner, as the case may be, any irregularity on the part of these subordinates. He shall not, however, issue orders to them of any character other than as to the delivery for persual of any document. But, on report being made by him to the President, District Board, through the District Medical and Sanitary Officer, as to any defect in vaccination methods or in reference to any supposed falsification, the Sanitary Assistant may be temporarily invested with power by the President, District Board, to issue orders in connection with such investigation as to vaccinators and by the Sanitary Commissioner in respect to deputy inspectors of vaccination ; such power shall cease with the termination of his investigation.

A.

PROGRAMME of work to be done by the Sanitary Assistant to the District Medical and Sanitary Officer, District, for the month of 191 .

Taluk.	Village number.	Name of union, village, hamlet, or other place, to be visited.	Probable date of visit.	Probable date of departure.	Distance from head-quarters.	Distance from last village visited.	Date of last visit.	Purpose of visit.	Remarks.
1	2	3	4	5	6	7	8	9	10

B.

DIARY of the Sanitary Assistant to the District Medical and Sanitary Officer, for the week ending 191 .

Date.	Name of place visited.	Population.	Distance from head-quarters.	Distance from last place visited.	Date of last visit.	Nature of work done	General remarks as to sanitation, vaccination, registration and epidemics, if any prevailing.
1	2	3	4	5	6	7	8

RULES FOR EDUCATION AND DISCIPLINE OF SANITARY INSPECTORS.

THE scheme for the training of Sanitary Inspectors was sanctioned by Government in December 1891, and the first class for Sanitary Inspectors assembled in the Medical College, Madras, in January 1895. The general educational qualification for admission to the class was the Matriculation or any higher examination, but a certain number of unpassed candidates were also admitted on the nomination of the Sanitary Commissioner. Also unqualified Sanitary Inspectors in the service of local authorities and having less than five years' standing, whatever their educational qualification, were required to qualify within two years or be discharged. The training consisted of theoretical instruction in the Medical College extending to three months from January to March, and a practical course extending through April. Men who qualified under the above rules are known as Certificated Sanitary Inspectors.

2. The examination prescribed for those wishing to qualify as Sanitary Inspectors was the Government Technical Examination in Hygiene (Intermediate Grade) modified by the Director of Public Instruction, in consultation with the Sanitary Commissioner, to suit the special requirements. Subsequently, Elementary Physiology was added as part of the course of instruction; but no compulsory examination was held.

3. In 1903, the scope of the examination and training was enlarged. Under the new rules the nomination of unpassed candidates ceased, and none but those who have passed the Matriculation Examination of the Madras or any recognised University, the Upper Secondary, or any higher examination, are admitted to the Medical College. Admission is also conditional upon candidates being of good character, certified by the Head of their Schools or Colleges, or their employers.

4. The course in the Medical College, Madras, extends from July to December, and consists of theoretical and practical training in General Hygiene, Physiology and Bacteriological Demonstrations under the Professor and Assistant Professor of Hygiene. Out-door practical teaching is undertaken by these officers assisted (voluntarily) at times by the Health Officer, Madras. The text-books used are McNally's "Hygiene" and Shore and Foster's "Physiology" for beginners. The fee for the course is Rs. 30. Application for admission to the Medical College should be addressed to the Principal, Medical College. The syllabuses for the subjects are exhibited in Appendix A.*

5. Candidates who qualify under the above rules are known as Assistant Sanitary Inspectors.

6. The examination prescribed for Assistant Sanitary Inspectors is the Government Technical Examination in the Intermediate Grade in Hygiene and in Physiology, and is conducted by the Commissioner for Government Examinations. The fee for registration is Rs. 4. No candidate will be permitted to appear for it unless he produces a certificate from the Principal, Medical College, of having undergone the five months' theoretical and practical course in the Madras Medical College. The written examinations consist of two papers of three hours each in Hygiene (one of a theoretical, the other of a practical, tendency) and one of three hours' duration in Physiology. There are also oral and practical examinations in the above subjects.

7. Candidates who are desirous of qualifying for the higher grade of Sanitary Inspector must, in addition to passing the examinations for Assistant Sanitary Inspector as above described, undergo a course in Minor Sanitary Engineering at the King Institute, Guindy, Madras, which extends to five months, viz., from January to May. This course may precede that required for Assistant Sanitary Inspectors; but it is preferable the candidates should first pass the test for the latter grade; more especially as no certificate of qualification can be acquired until this has been done.

8. The text-book used is Jones's "Manual." The syllabus for this course is exhibited in Appendix B.† The fee for the course is Rs. 20.

9. The examination in Minor Sanitary Engineering is conducted by the Commissioner for Government Examinations, but no candidate will be permitted to appear unless he produces a certificate from the Lecturer in Minor Sanitary Engineering of having undergone five months' training at the King Institute. The fee for registration for the examination is Rs. 4.

10. Candidates who duly pass the examination for Assistant Sanitary Inspectors will be given two certificates—one by the Commissioner for the Government Examinations, in token of having passed the Government Technical Examination (Intermediate Grade) in Hygiene and Physiology, and another conjointly by the Surgeon-General and the Sanitary Commissioner. *The latter certificate is the token of qualification.* A person not possessed of this certificate and whose name does not appear in the ‡Quarterly List of Sanitary Inspectors, which is published under the authority of Government, is not entitled to hold an appointment under any public authority in the Madras Presidency. The certificate is granted only to those who have passed the examination after undergoing a course of study in the Medical College, and its grant is conditional on the candidate being of good character and physique. It is the property of the Sanitary Commissioner for the time being, and is liable to be cancelled or suspended by him in case of misbehaviour. Whilst in the employ of a local body, the certificate should be lodged by the Sanitary or Assistant Sanitary Inspector concerned in the office of the District Medical and Sanitary Officer; when not so employed, it is held in the private possession of the Sanitary Inspector. On securing employment, the Sanitary Inspector should not only report himself to the local body paying for his services, but also through that body to the District Medical and Sanitary Officer, sending, at the same time, his certificate. The following is a copy of the certificate and the conditions upon which it is given :—

Sanitary Inspector's Certificate.

THIS is to certify that _____ has passed the Intermediate tests in Hygiene and Physiology of the Government Technical Examinations after undergoing a course of lectures and practical instruction at the Medical College, Madras; and that he has, therefore, in my opinion received a training that should qualify him for the post of Assistant Sanitary Inspector under Municipal Councils or Local Boards in the Presidency of Madras.

OFFICE OF THE SURGEON-GENERAL }
WITH THE GOVT. OF MADRAS, }
DATED 190 . } *Surgeon-Genl. with the Govt. of Madras.*

* Page 215.

† Page 217.

‡ Obtainable from the Superintendent, Government Press, Madras, by any person on payment of As. 12. It is of great importance that each Sanitary Inspector should provide himself with a copy.

THIS is to certify that, in accordance with the above certificate, has been registered in this office as an Assistant Sanitary Inspector, and that such registration is subject to the continuance of good conduct in his professional capacity and, during employment, to evidence, given at such annual examination as may from time to time be prescribed by the undersigned, that he has taken reasonable measures to maintain a sound theoretical and practical knowledge of Hygiene.

Sanitary Commissioner for Madras.

Reverse.

(a) This certificate is issued on the understanding that it is the property of the Sanitary Commissioner for the time being, and can be withdrawn by him without reasons being assigned.

(b) On obtaining permanent employment, the Sanitary Inspector should lodge the certificate in the office of the District Medical and Sanitary Officer of the district in which such employment is obtained.

(c) The person named in this certificate is entitled to use the designation—Qualified Assistant Sanitary Inspector. In official correspondence the designation should be invariably added after the name, and no other contraction than the following should be employed :—Qual. Asst. San. Insp.

Sanitary Commissioner for Madras.

11. Similarly, those who have qualified as Sanitary Inspectors by passing the examination for Assistant Sanitary Inspector and in Minor Sanitary Engineering are given a certificate by the Commissioner for Government Examinations, whilst in the case of those who have been given the conjoint certificate alluded to above, a note will be added thereto by the Sanitary Commissioner to the effect that the holder has qualified by further study as a Qualified Sanitary Inspector.

12. The designations of Assistant Sanitary Inspector and Sanitary Inspector are strictly confined to those who have qualified as above, and are not applicable to Nuisance Inspectors, Conservancy Overseers, etc. Sanitary Inspectors should, through the employing bodies, bring to the notice of the Sanitary Commissioner any instance where the term of Sanitary Inspector is used by unqualified persons. *Both the honour and the use of these designations should be jealously guarded by those possessed of them.*

13. After the 1st January, 1906, no person who has not qualified under the rules which came into force in 1903 (G.O., No. 697, dated 9th June, 1903) will be appointed as Sanitary Inspector or as Assistant Sanitary Inspector under local bodies. In order, however, to prevent hardship to the large body of men who have qualified under the old rules, it has been decided by Government that this rule shall not apply to any Certificated Sanitary Inspector who, on the 31st December, 1905, holds a permanent post as Sanitary Inspector, or as Superintendent of a Vaccine Depot under a local body, or as a Deputy Inspector of Vaccination in the Madras Vaccination Department, or who can prove by extracts from the register of Certificated Sanitary Inspectors maintained in the Sanitary Commissioner's office that he has within two years previous to that date so served any local body as a Certificated Sanitary Inspector or Certificated Assistant Sanitary Inspector on temporary plague or cholera duties, and that his conduct during that period has been satisfactory.

14. Men qualified as above are eligible for permanent employment as Sanitary Inspectors or Assistant Sanitary Inspectors in Municipalities or in Local Fund areas, and for temporary employment during fairs and festivals, or on the occasion of epidemics; as rural Observation or Preventive Circle, Disinfection or Divisional, Inspectors on plague duty; also as Deputy Inspectors of Vaccination, provided they have also undergone training and examination in Vaccination at the King Institute of Preventive Medicine, Guindy, in the following subjects :—

Subjects.	Number of lectures.
(1) Preservation and Bacteriology of Vaccine, and the Science of Asepticism	6
(2) Human and animal vaccination (theoretical). Official routine and law concerning vaccination	12
(3) Common skin and other diseases of man (theoretical)	8
(4) Human and animal vaccination (practical)	} Daily for 3 months.
(5) Common skin and other diseases of man (practical)	
(6) Common skin and other diseases of animals (theoretical)	8

15. No Municipal Council should newly employ any person as a Sanitary Inspector who does not hold a certificate of having qualified under the above rulings.

16. All appointments of Sanitary Inspectors are made by Municipal and Local Fund authorities, subject to the Sanitary Commissioner's approval as to character. This should be formally sought before giving the candidate an appointment. Selections should be made from the Quarterly List of Sanitary Inspectors published every quarter by the Sanitary Commissioner, which is circulated to local bodies. Government also expects that these bodies will seek his advice as to choice of men, in respect to fitness for the particular appointments concerned. The appointment by local bodies of any person whose name does not appear in the Quarterly List of Sanitary Inspectors, or who has not been approved as to character by the Sanitary Commissioner, will be brought to the notice of Government by the Sanitary Commissioner.

17. The *minimum* salary fixed for Sanitary Inspectors is as follows :—

For towns with a population below 20,000... ..	Rs. 25 to Rs. 30 in Northern Circars and Ceded Districts, and Rs. 20 to Rs. 25 elsewhere.
For towns of 20,000—30,000 inhabitants	Rs. 30—1—40.
For towns of 30,000—40,000 inhabitants	Rs. 40—1—50.
For towns of 40,000—60,000 inhabitants	Rs. 50—1—60.
For towns of 60,000 inhabitants and upwards	Rs. 60—1—70.
Assistant Sanitary Inspectors in subordinate charge of a part of a town.	Rs. 25 to Rs. 30 or Rs. 20 to Rs. 25 according as it is in the Northern Circars and Ceded Districts or elsewhere.

Sanitary Inspectors in rural areas employed on fairs, festivals or epidemics. Rs. 30—1—40.

18. The grant of conveyance allowance by local authorities depends upon the circumstances of each case.

19. All Sanitary Inspectors are under the immediate control of the bodies under which they are employed.

20. In Municipalities, Sanitary Inspectors must maintain a diary in which all sanitary reports and recommendations shall be written daily. This diary shall be submitted daily to the Chairman, who will record in the margin his orders or the action he has taken thereon, and it shall be liable to inspection by the Collector, the Divisional Officer, the District Medical and Sanitary Officer, and by the Sanitary Commissioner and his Deputy. When the Local Medical Officer is of or above the rank of Assistant Surgeon, it shall be submitted to him for inspection not less than once weekly. When for any purpose a separate and special report from a Sanitary Inspector is required by the Chairman and is not entered in the diary, a précis of the report and order passed thereon by the Chairman shall be entered in due chronological sequence in the diary by the Sanitary Inspector.

21. Sanitary Inspectors are entitled to all the advantages as to leave, &c., possessed by other officers in Local Fund or Municipal employ.

22. To maintain discipline among Sanitary Inspectors, a register is maintained in the Sanitary Commissioner's Office in which is recorded everything in favour of or against a Sanitary Inspector as reported by employing officers, and as a result of observation by District Medical and Sanitary Officers, the Deputy Sanitary Commissioner and the Sanitary Commissioner. The Sanitary Commissioner is empowered to remove from the register any Sanitary Inspector who has misbehaved himself, and to cancel or suspend his conjoint certificate according to the gravity of the offence. During the temporary suspension of the certificate, the employment of the Sanitary Inspector under any public authority is prohibited. It is, however, open to any one whose name has been removed from the register to appeal to Government, through the Sanitary Commissioner, against the decision of that officer.

23. Sanitary Inspectors should remember that all their educational course can afford them is an awakening to the importance of certain broad facts in sanitation and their practical application. Sanitation being a science which is daily making rapid advances, if they wish not to be left in ignorance as time rolls on, they must be prepared by constant study of suitable books to maintain their knowledge. Their text-books (McNally's "Handbook of Hygiene" and Grant's revised edition of King's "Hygiene") should, therefore, be frequently appealed to with the object of refreshing their memories during practical work. Other standard works, such as mentioned below, should also be in their possession for reference :—

"Theory and Practice of Hygiene" by Notter and Firth (J. & A. Churchill).

"Water-supply" by Thresh (Rebmann Publishing Company, London).

"Sanitary Engineering Notes" by Moore (published by the Royal Engineering Institute, Chatham, sold also by Hamilton Adams & Co., London).

"Disinfection and the Preservation of Food" by S. Rideal (The Sanitary Publishing Company, Limited, London).

"Sewage and Sewage Purification" by S. Rideal (Robert Ingram, Pleydell House, Pleydell Street, Fleet Street, London, E.C.).

"Sewage and Sewage Disposal" by Henry Robinson, C.E. (E. and F. N. Spon, 125, Strand, London).

They should also keep themselves fully acquainted with all changes in policy and sanitary methods sanctioned by Government for combating plague, cholera, small-pox, and other epidemic diseases. All changes in Law affecting sanitation in Municipal and Local Fund areas should also be watched. Considerable information as to current facts of a nature suitable for Sanitary Inspectors can be obtained by reading the "Sanitary Record" and "Indian Public Health," which the undersigned has advised all local bodies to take for the benefit of their Sanitary Inspectors. Further, some little information may at times be obtained from the "Quarterly Proceedings of the Sanitary Commissioner for Madras," showing what improvements are being effected and what defects have been ascertained in various parts of the Madras Presidency. As these Proceedings are circulated to all local bodies, they can be obtained by Sanitary Inspectors from the body employing them.

24. To ensure that Sanitary Inspectors keep up their study and be in touch with sanitary advance, those who are in the employ of local bodies are examined annually by the District Medical and Sanitary Officer, and the results of such examination are communicated to the Sanitary Commissioner. If the result in any case is stated to be "bad," the individual is examined again at the end of three months, and if the results are again held to be "bad," his certificate is suspended until he improves. The travelling allowance of Sanitary Inspectors coming up for their annual examination from stations beyond the head-quarters of the District Medical and Sanitary Officers is paid by the local body concerned.

25. To secure employment, candidates should register their names at the office of Sanitary Commissioner, giving the following information. Any change of address should at once be intimated :—

(a) Age.

(b) Languages known and whether knowledge is colloquial only or extends to reading and writing.

(c) Examinations passed.

(d) Where employed and length of service in each capacity.

(e) Date of appointment in present post.

(f) Permanent address.

(g) Father's name and profession.

26. Local authorities will be supplied with information as to candidates on application.

27. To enable the Sanitary Commissioner to meet the requirements of Government as to the maintenance of a register, all local authorities employing Sanitary Inspectors are requested to intimate to the Sanitary Commissioner any matter in favour of or against their conduct, and the date of first joining and giving over charge of an appointment. The latter detail is of particular utility in regard to the prompt supply of Sanitary Inspectors for plague duty under Regulation 56 (4) of Madras Plague Regulations in force outside the Presidency Town and Appendix II-S and footnote thereto.

APPENDIX A. TO ANNEXURE 3.

HYGIENE. INTERMEDIATE EXAMINATION.

1. *Local Conditions: soil, climate and meteorology.*—General characters of soil and sub-soils; the choice of sites for buildings; aspect; elevation; coast and inland climates; influence of surroundings, such as swamps, various kinds of vegetation, etc.; winds; rainfall; humidity; temperature; diseases connected with the soil.

2. *Water.*—Sources; composition, characters and classification of potable water; origin of impurities in drinking-water; conservancy; purification; prevention of pollution of tanks and wells; diseases caused by impure supply.

3. *Air.*—Composition; impurities, their sources and effects; simple methods of testing the principal impurities; action of animals and plants on the air; cubic space necessary for each person; dangers of overcrowding; natural and artificial ventilation.

4. *Waste and impurities.*—Disposal of excreta, sewage and refuse; the principles of construction of latrines on the dry and on the wet system; temporary latrines; cesspools; dung-hills; control of offensive trades and disposal of their refuse; the principles of house and street drainage; open and closed drains; the disposal of dead bodies; the regulation of burial and burning grounds; diseases specially connected with filth.

5. *Personal hygiene.*—Habits; exercise; principles of physical training; effects of a sedentary life; sleep and sleeping places; cleanliness; washing; attention to the skin and the bowels; the principal parasites of man and methods for their removal; clothing materials, their properties and suitability to different conditions of temperature and climate; effects of early marriage; effects of vicious excesses and intemperance; effects of tobacco and opium on the health.

6. *Food and Diet.*—Physiology, classification and uses of food substances, quantity of each class required; energy obtainable from food; animal and vegetable foods; general principles and requirements of a diet; the preparation and cooking of food; hours for meals; effects of excess and deficiency of food; condiments, alcohol, tea, coffee and aerated waters as articles of diet; wholesomeness and unwholesomeness of food; adulteration; the principal adulterations of milk and its products, and simple methods for their detection; foods in common use in the Madras Presidency and among the different castes and classes of the population; diseases specially connected with food.

7. *Disease.*—Contagion; the media in which contagia are spread; epidemic and endemic disease; the germ theory and its application in sanitary work, rabies, anthrax, glanders, cholera, small-pox, rinderpest, epizootic aptha (foot and mouth disease); the principles of protective inoculation; general preventive measures; the notification of infectious diseases, action of antiseptics, disinfectants and deodorants; the effect of heat as a disinfectant; preventive measures applicable to the case of large gatherings, such as fairs and festivals.

8. *Vital statistics.*—Population; census; registration of birth and deaths; ratios; means.

9. Method of inspection and reporting upon the sanitary condition of rural and urban areas dwellings, slaughter-houses, places for the conduct of offensive and dangerous trades, grave-yards, rubbish and night-soil depôts, sewage farms, cattle yards, dairies, stables; physical examination of grains, bread, milk, and its products, meat, fish, vegetables and fruits; the use of apparatus designed for the conduct of night-soil and rubbish conservancy, water-supply and sewerage of towns; disinfection of dwellings and of clothing; the organisation and practical working of a staff organised for dealing with an epidemic disease.

10. *Sanitary law.*—A knowledge of the sanitary clauses of the various Acts in force in the Madras Presidency, sufficient to enable the candidates to decide promptly as to what action can be legally taken or initiated by them.

The examination shall comprise—

- (1) A written examination on the above.
Two papers each of three hours' duration.
- (2) An oral examination.
Candidates will be required to show a general knowledge of the organisation and the objects of administration of District Boards and Municipalities, and the relation of these bodies to the various departments of Government.
- (3) A practical examination—
By means of a written report, and an oral examination thereon.

The distribution of marks and minima required for passing shall be as follows :—

	Max.	Min. for passing.	
		1st class.	2nd class.
Written examination	70	—	—
Oral and practical examination	30	20	10
Total	100	65	40

Text-books recommended :—

- C. J. McNally's "Elements of Sanitary Science."
- H. King's "Manual of Hygiene" (revised edition).
- J. A. Jones's "Manual of Hygiene, Sanitation and Sanitary Engineering."
- W. G. King's "Plague Inspector's Manual."

The following may also be consulted :—

- Madras Municipalities Act IV. of 1884. Madras Local Boards Act V. of 1884. Madras Act II. of 1866. Madras Act I. of 1884, amended by Madras Act II. of 1892. Penal Code, chap. 14.
- Rules for Medical Inspection and Quarantine of Shipping.

Annual Reports of the Sanitary Commissioner for Madras.
Report on the Madras Census of 1881, vol. i, portions of first 100 pages ; and vol. iii, pp. 5, 40 and 41.
Report on the Madras Census of 1891 by H. A. Stuart.

ANIMAL PHYSIOLOGY.—INTERMEDIATE EXAMINATION.

- (A) *Anatomical preliminaries.*
The general build of the body. The nature of organs and tissues. The more obvious characters of :—integument, mucous membrane, connective tissue, tendon, ligament, bone, cartilage, muscle, and nerve.
The more obvious characters as to form, position, and uses of the various bones in the trunk and limbs. The general characteristics and uses of the skull.
The position in the body and general form of the following organs :—the brain and spinal cord, the pharynx, gullet, stomach, and intestines ; the salivary glands, liver, and pancreas ; the nasal passages, larynx, trachea and lungs ; the heart and great vessels ; the kidneys, urinary bladder, and urinary passages ; the spleen ; the diaphragm.
- (B) *Chemical and physical preliminaries.*
The rudiments of animal chemistry : carbon, hydrogen, oxygen, nitrogen.
The composition of air, water, carbonic acid, urea, ammonia, carbonate of lime, and phosphate of lime.
The more important chemical characters of proteid substances, fat, starch and sugar.
The nature of combustion.
The general principles of the diffusion of gases, and osmosis.
The ultimate chemical products of the decay and putrefaction of the dead body.
- (C) *General view of the animal body in action.*
The evidence that the body constantly wastes during life. The nature of the waste products and of the compensation for waste. The part played by oxygen in the economy. The essential characters of food stuffs.
The blood as a medium of communication.
The nature and use of secretory glands.
The physiological properties of muscular tissue.
The modes in which muscles give rise to movements.
The physiological properties of nervous tissue. The position and uses of the sensory organs.
The relation of the nervous system to muscles and to sensory organs. The general functions of the brain and spinal cord.
Local and general death.
- (D) *Special physiology.*
A general account of the circulatory, alimentary, respiratory and urinary systems.
The functions of the liver.
The sources of the heat of the body and the manner in which the heat is distributed and regulated.
The functions of the sweet glands.
- The examination shall comprise—
(1) A written examination.
One paper of three hours' duration.
(2) An oral examination.
(3) A practical examination.
- The candidates will be required to identify, and to answer questions on, the various organs and tissues mentioned in the syllabus.

The distribution of marks and the minima required for passing shall be as follows :—

						Max.	Min. for passing.	
							1st class.	2nd class.
Written examination	...	...	...	...	...	60	...	...
Oral examination	...	...	...	...	...	20	24	15
Practical examination	...	...	...	...	...	20		
Total					...	100	60	40

SYLLABUS OF THE DEMONSTRATIONS IN BACTERIOLOGY FOR ASSISTANT SANITARY INSPECTORS.

Place of bacteria in nature.
Their universality in the soil, air, water, &c.
Exposure of a petri dish to air. Inoculations of broth tubes with tap water, cooam water, sterile water, cowdung soil, the cleanest handkerchief in the class and a wire lying on the table. Exhibition of the tubes and plates on the next day together with the controls.
Comparison with plants and animals. Mode of nutrition and reproduction. Excreta or toxins found in the surrounding medium, sometimes virulent, sometimes not. Resistance to desiccation.
Demonstration of a mould under the microscope showing mycelia and sporangia.
Demonstration of yeast cells under the microscope.
Demonstration of blood cells under the microscope.
Shapes of bacteria. Size of bacteria. Demonstration of bacteria of different shapes—cocci, diplococci, staphylococci, streptococci, vibrios, rods : motility and sporing.

Elementary remarks on the use of the microscope.
 Demonstration of motile typhoid bacilli and non-motile bacilli (anthrax) and sporeforming microbes (anthrax bacilli) both stained and unstained.
 Yeasts and fermentation. Collection of gas in fermentation tubes.
 Demonstration of acid formation by lactic acid bacillus in litmus agar, and gas formation in sugar agar by sewage bacteria.
 Briefly—methods of preparation of media, methods of cultivation and isolation by plating.
 Life history of bacteria. Relation of bacteria to different diseases. Channels of infection, modes of exit from the body, demonstration of cocci in pus from wounds, tubercle bacilli in sputum.
 Sterilization by physical and chemical processes.
 Demonstration of the effects of heating in an autoclave, of boiling, of the addition of carbolic acid, perchloride of mercury, in broth cultures of typhoid bacillus and the sporeforming (Hay bacillus) by subsequent inoculation of fresh tubes with a loopful of the contents of these broth cultures. Controls in all cases.
 Bacteriological examination of water. Plating and enumeration of the colonies.
 Demonstration of the following organisms under the microscope in the stained condition:—
 Plague, cholera, typhoid, diphtheria, anthrax, staphylococci, streptococci, gonococci, tubercle, micrococcus, melitensis leprosy, streptothrix, madura, plasmodium malarie, bilharzia, acarus scabiei.
 The preparation of blood films (done by each student).
 The preparation of films from sputum (done by each student).
 The collection of blood for the Widal reaction (done by each student).
 The packing of mosquitoes, ticks, &c.

APPENDIX B. TO ANNEXURE 3.

SYLLABUS FOR LECTURES IN MINOR SANITARY ENGINEERING FOR SANITARY INSPECTORS.

General.

The use of drawing instruments. The use of scales. The reading of plans and sections. The calculation of gradients. Chain surveying and the practical use of levelling instruments.
 The measurement of areas and volumes including the calculation of small quantities of earthwork, brickwork, masonry, &c. Estimating for minor and temporary works.

Buildings.

The description of soils and strata best suited for the erection of buildings in respect to stability and healthiness of the dwellings erected thereon. The necessity for foundation, their proper depth, &c.
 Knowledge of the various building materials, such as brick, stone, limesurki, asphalte, paints, &c. Their quality and the possible influence of the atmosphere on them. Their suitability for use in various parts of a building. To distinguish between good and bad brick, timber, lime, cement, &c.
 The methods of ventilation applicable to Indian conditions.
 Main details of the construction of permanent and semi-permanent hospital wards as gained from a study of plans.
 The area and cubic space required in ordinary and contagious wards.
 The details of design of latrines as gathered from a study of plans—permanent and temporary.
 Details of night-soil depôts and a knowledge of method of trenching, covering, &c.

Water-supply.

The inspection of sources of supply and determination by inspection as to their suitability for dietetic purposes.
 The proper construction of wells to prevent the inlet of surface-polluted water.
 The calculation of the capacity of a well and the average supply of water likely to be obtained from it.
 Methods of filtering and purifying small quantities of water or of otherwise rendering it safe for domestic use.
 The method of drawing samples of water for chemical examination from water taps, tanks and streams.
 Simple methods of calculating the discharge of small channels.
 The various methods of raising water used in India and the construction of the ordinary lift and force pumps.
 The use and construction of small cisterns and tanks for the storage of water.
 The quantity of water necessary per diem per head for a town population and for horses and other animals.
 The method of driving tube wells, their use, and the position in which suitable.

Drainage.

The materials used in drainage works.
 The use of drainage pipes, glazed and unglazed, brick drains, syphon traps, cesspools, septic tanks, &c.
 The various methods of house and street drainage.
 Knowledge of methods for the rough determination of the discharging capacity of an open drain, channel, closed pipe and sewer.
 The proper gradients for drains of varying sizes.
 The various methods of pipe-jointing in closed drainage and sub-soil drainage.
 The variation in sub-soil water-level and its effect on health.

The methods of excluding sub-soil water from areas and spaces below ground level.
The methods of flushing and cleaning drains and drain testing.

Disposal of Sewage, &c.

Methods of sewage purification. The action of the septic tanks, bacterial and other filters, and of land, &c.

The relation of the septic tank to the old cesspool.

Simple plant for domestic sewage disposal.

The formation of small collecting tanks and areas for sewage filtration.

The proper crops to grow under sewage irrigation.

The sub-soil drainage of sewage farms when necessary and when not.

The maximum area which can be irrigated by any quantity of sewage.

The maximum amount of sewage which can be put in an area to ensure a maximum return in relation to temperature and climate.

No. 6.

*Despatch from the Secretary of State for India to the Government of India,
Revenue No. 40, dated 26th April, 1912.*

I have considered in Council the letter of Your Excellency's Government, No. 3 (Finance), dated the 4th January 1912, on the subject of the improvement and extension of the sanitary services in India.

2. The first proposal is for the appointment of additional Deputy Sanitary Commissioners. You ask for sanction to the creation of two such posts in each of four Provinces, or eight in all, but state that for the present one will probably suffice in Eastern Bengal and Assam, and that in any case this portion of the scheme will require re-adjustment in view of impending administrative changes. I sanction your proposals and approve the instructions which you have given to the Local Governments with regard to rates of pay and other conditions of appointment in cases in which the new posts are held by persons not belonging to the Indian Medical Service. I note that the selection of Deputy Sanitary Commissioners will rest with the Local Governments, and that for these posts Indians will be eligible who hold a British diploma in public health and a registrable medical qualification.

3. Your second proposal is that with a view to enabling Local Governments to establish scientifically trained health officers and sanitary inspectors in the larger municipalities, you should grant to those governments who cannot find the money from provincial funds an annual subsidy "calculated approximately at the cost of the additional Deputy Sanitary Commissioners at the rates proposed for non-Indian service, men, plus half the cost of the municipal health officers for the towns in which, as indicated in their detailed proposals, Local Governments consider such officers should be appointed," the cost being based on the rates of pay mentioned in paragraph 8 of your circular letter of the 10th November, 1911. You contemplate that the other half of the cost of the health officers should be provided by the Local Governments and the towns concerned, and that the Local Governments will also be able to give assistance towards maintaining a subordinate staff of inspectors to such municipal bodies as require it. In support of this proposal it is urged that the Local Governments require to be assisted to bring the scheme into force without further delay; and it is stated that the recurring grants which you have already made for sanitation, together with any grants from provincial revenues which Local Governments have been able to afford, are expended to the full in the provision of drainage and water supply. The cost of the subvention is approximately estimated by you at Rs. 2,30,000 (15,333*l.*), and as this sum has been provided in the estimates of 1912-13, it is evidently contemplated that all the Local Governments will be granted assistance to the full permissible extent if they apply for it.

4. In view of the great importance of sanitation and the present imperfect and unequal development of sanitary measures in the several provinces, I sanction your proposals. At the same time, I feel that your action in tendering to Provincial Governments an offer of subsidies in aid of the cost of the scheme is not altogether free from the objection that it has the appearance of a return to the policy of "doles," described in paragraphs 75 and 76 of the Decentralisation Commission's Report, and examined and condemned in paragraph 7 of your letter No. 310 (Finance), dated the 22nd November, 1910, on the subject of the future working of Provincial Settlements.

I have, &c.,

(Signed)

CREWE.

No. 7.

Memorandum by the Sanitary Commissioner with the Government of India regarding the measures taken for the suppression of malaria and plague in India dated 15th September, 1911.

1. The registration of vital statistics in India, except in a few of the towns, is necessarily carried out by means of an illiterate agency with the result that the registered causes of death are always very misleading. For this reason it is not possible to indicate with any degree of accuracy the direct effect of scourges like malaria and plague upon the growth of populations, but there can be no doubt that in some Provinces they have been among the most important causes of the low figures recorded at the census of 1911. The provisional totals of that census show that in the United Provinces and the Punjab the present populations are actually less than the populations in 1901, and although it is difficult to appraise the relative importance of the many and various factors to which this unfortunate result is due, the great influence of the terrible epidemics of malaria and of plague from which those Provinces have suffered during the decade must be admitted. The adverse effects of plague are chiefly manifest in an enormous increase of mortality, but epidemic malaria is disastrous not only in that way but in bringing about a great reduction in the number of births during the year following the epidemic. In the United Provinces the first four years of the decade preceding the recent census were a period of returning prosperity after the famines of 1897 and 1900, but in 1905 the crops were again bad and in 1906 famine occurred in Bundelkhand and the south of the Agra Division. In 1907 the monsoon failed entirely in August, causing a severe famine which continued until 1908, when the provinces were devastated by the most severe epidemic of malaria ever experienced in them, and during the decade as a whole the deaths recorded as due to fever exceeded those during the previous decade by more than $1\frac{1}{2}$ million. Plague appeared in the Provinces in 1897, but the deaths during the decade prior to the census of 1901 numbered only 362 as compared with 1,314,746 during the decade prior to the census of the present year. In the Punjab the decade as a whole was one of considerable agricultural prosperity, but the state of the public health was deplorable. Prior to the census of 1901 the deaths from plague in the province had numbered only about 3,000, but during the decade preceding the census of 1911 the deaths from that disease were over two millions. In 1908 the Province was visited by one of the very severe epidemics of malaria to which at intervals it is subject, and for the decade as a whole the number of deaths recorded from plague and fevers together exceeded the number during the previous decade by more than $1\frac{3}{4}$ million.

2. At the outset of any attempt to describe the measures that are being taken to eradicate malaria and plague from India it may not be out of place to record the fact that to the action taken and to the discoveries made in this country not only India but the world in general owes almost the whole of the knowledge upon which efficient and precise measures against those diseases are everywhere based. As regards malaria it may be recalled, firstly, that the Cinchona enterprise of the Government of India, commenced more than 50 years ago, has been the chief means of bringing about such a fall in the price of quinine as to render practicable the policy of making the drug available to the poorest peasants throughout the world; secondly, that India was the first country in which an endeavour was made to mitigate malaria among the poor by the plan of selling single doses of quinine for the smallest coin in general daily use among the people; and, thirdly, that to an officer of the Indian Medical Service (Sir Ronald Ross) belongs the credit of the discovery of the mode by which the disease is contracted and spread, and therefore the discovery of the precise measures by which alone its eradication is possible. As regards plague we may recall firstly the discovery and provision of an effective mode of protection in inoculation; secondly, the attainment of exact knowledge regarding the part played by rats in the epidemiology and endemology of the disease; and thirdly, the discovery of the mode of infection and conveyance by means of the rat-flea, which has led to the abandonment of many useless and very troublesome measures, previously considered essential, and has rendered it possible to name accurately the particular methods necessary for the avoidance and prevention of the disease.

3. The measures which are at present being taken for dealing with malaria are based upon the recommendations of an Imperial Conference on the subject which was held at Simla in October 1909. The Conference considered that the first step in a satisfactory

and widespread endeavour to deal with malaria in this country should be the establishment of a permanent organisation comprising:

A Central Scientific Committee.

Provincial Committees.

A General Committee consisting of the members of the Central Committee and delegates from the Provincial Committees.

The progress that has been made in the establishment and work of this organisation is fully described in Nos. 1 to 3 of the publication "Paludism" which is laid on the table. The deliberations of the Conference showed that a first essential in the campaign against malaria is a complete knowledge of all the circumstances connected with the disease in different localities, and to secure this it was arranged, early in 1910, that each Province should be given an opportunity of training a number of officers and subordinates in modern methods of malarial research. To this end there was established at Kasauli a Central Malaria Bureau, containing a museum, laboratory and reference library, and at Amritsar a house was secured which serves as a permanent laboratory for malarial investigation and teaching. At the latter place three classes of instruction under Major Christophers, I.M.S., have been held, the number of officers and subordinates who have attended them being 48 in all. The next step was the appointment in the different Provinces of specially trained officers and subordinates whose sole duties are in connexion with malaria. These officers are provided with adequate working staffs and tour from place to place investigating the disease and assisting in its prevention. The measures now being undertaken in the several Provinces are briefly the following:

Madras.—A Malaria Board is to be constituted and a special malaria officer is to be deputed for three years. Another officer, Major Perry, I.M.S., has been deputed under the instructions of the Central Committee to investigate the malarial circumstances of the Jeypore Agency in this Presidency. In some parts of the area of investigation malaria is very severely prevalent and in others only very moderately so, and it is hoped that important practical results in connexion with the best methods of preventing malaria will accrue if the causes of the variations of malarial intensity can be ascertained. In 1910 the practical anti-malarial measures carried out in the Presidency included the introduction of effective drainage in different places, the filling up of useless ponds and pits, the prohibition of wet cultivation in proximity to dwellings, the destruction of mosquito larvæ by petrolage and the free distribution of quinine in malarious areas.

Bombay.—The Sanitary Board has been appointed the Provincial Committee for dealing with malaria. One of the Deputy Sanitary Commissioners, Major Hutchinson, I.M.S., attended the first malaria class at Amritsar and on his return arrangements were made for the collection and compilation of mortality statistics on the lines recommended by the Central Committee. For the investigation of malaria in Bombay City, Dr. C. A. Bentley was on special duty from 1909 to 1911, and his valuable final report has just been published and is laid on the table. It proves conclusively the necessity for detailed investigation before great sums of money are spent on schemes designed to effect the improvement of malarial conditions, and indicates that in Bombay carefully devised measures for the destruction of the dangerous species of anopheles mosquito would very probably result in complete eradication of malaria from the city. If vigorous and proper measures are taken by the municipal corporation, on whom the carrying out of the measures devolves, the Government of Bombay will assist them with a grant of one lakh of rupees from Provincial revenues. The other anti-malarial measures carried out in this Presidency during 1910 included the deputation of 27 sub-assistant surgeons to carry out operations for the mitigation of malaria in certain selected districts.

Bengal.—The Sanitary Board is the Provincial Committee for dealing with malaria. A specially trained officer, Captain Fry, I.M.S., has been appointed for malaria research in the Province, and has been provided with a staff of assistants which will be increased as necessity arises. The anti-malarial measures carried out in 1910 included minor measures of draining and petrolage in several towns and the construction of permanent masonry surface-drains. For the free distribution of quinine in affected districts, 23 sub-assistant surgeons were deputed. A proposal from the Local Government for a special engineering establishment for drainage schemes is under consideration.

United Provinces.—Major J. C. Robertson, I.M.S., was placed on special duty for malaria research in November, 1908, and during the remainder of that year and the greater part of 1909 Captain J. D. Graham, I.M.S., was also engaged in that work. In March, 1910, the latter officer was deputed to attend the malaria class at Amritsar, and in May he took over the duties of special malaria officer and has continued to perform them since. A Provincial Committee and eight Divisional Committees have also been established in these Provinces, and during 1910 various important enquiries into the

malarial circumstances of towns and rural areas as well as valuable educational and other measures for popularizing the use of quinine and making the drug available to the poor were actively carried on. In four selected districts travelling dispensaries toured from village to village giving medical relief to persons suffering from malaria and other diseases.

Punjab.—An influential Provincial Committee for dealing with malaria has been appointed and a specially trained officer, Lieutenant-Colonel J. R. Adie, I.M.S., with an adequate staff has been deputed as chief malaria officer. During recent years large quantities of quinine have been distributed gratuitously by various agencies. Early in 1909, Major Christophers, I.M.S., was placed on special duty to investigate the causes of the terrible epidemics of malaria which from time to time affected this Province. His very valuable report has recently been published and is laid on the table. It shows that periodical flooding is an important factor in the causation of epidemics of malaria in this Province and that the measures necessary for their prevention and control may quite possibly come within the range of practical politics. This matter is now under consideration.

Eastern Bengal and Assam.—In 1907 the Duars Planters' Association approached the Government of this Province with a memorial requesting that the services of experts should be procured to enquire into the nature and causes of Blackwater and other fevers and to suggest remedial measures. As a result, the Government of India ordered a special enquiry to be conducted by the Central Research Institute, assisted by an Advisory Committee. Major Christophers and Dr. Bentley were entrusted with the scientific portion of the investigations, and their report upon Blackwater Fever, which was published in 1908, as No. 35 of the Scientific Memoirs, is almost universally regarded as settling finally the vexed questions with regard to the etiology of that dangerous disease. A large proportion of the planters in the Duars have taken action in accordance with the findings of the report and the result has been a great diminution in the number of cases of Blackwater Fever and a much reduced amount of malaria among them. The second report by the same officers on malaria in the Duars was written in 1909, and in view of the importance of the results recorded in it the Local Government in March, 1910, appointed a Committee to enquire into the sanitary and economic conditions under which the tea-garden coolies live. Both reports are about to be published and action upon them is being taken. In addition a very complete organisation for dealing with malaria in this Province has recently been established, Dr. Bentley having been appointed special malaria officer on completing his enquiry into malaria in Bombay City. Among the anti-malarial measures adopted, in addition to organised attempts at mosquito reduction, is a new system for supplying quinine in a very effective and cheap form. The system is described in detail on page 93 of No. 2 of "Paludism." Six quinine demonstration camps will also be established and various important methods of educating the people in measures for the prevention of malaria form a noteworthy feature of the scheme in this Province.

Burma.—A Provincial Malaria Committee has been formed and Major Lalor, I.M.S., has been employed solely in malaria work.

Central Provinces.—The Sanitary Board is the Provincial Committee and a specially trained officer, Major Kendrick, I.M.S., has been appointed special malaria officer. The investigations were commenced in October, 1910, and some results of them will be found on page 98 of "Paludism" No. 2 and page 24 of No. 3.

Troops and prisoners.—It would occupy too much space to describe the carefully devised measures against malaria that have been carried out among these bodies of people for some years, but the following statistics will give an idea of the degree of success attained. Among European troops in India the rates of admission to hospital on account of malarial fever were 485 per thousand of average strength for the decennial period ending with 1888, 374 per thousand for that ending with 1898 and only 223 per thousand for that ending with 1908. The following table shows the fall in the rates among Indian troops and Indian prisoners :—

Quinquennial admission rates from malaria per 1,000 of strength.

	1889-1893.	1894-1898.	1899-1903.	1904-1908.
Indian Army	467·0	341·0	305·0	228·0
Indian Prisoners	393·0	320·0	277·0	199·0

3. When plague first appeared in India, nothing was known as regards the mode by which it is contracted and spread, and all that could be done was to attempt to eradicate it by the means adopted in European countries for dealing with epidemic disease. With this object very strenuous efforts were made, but success was not attained and sometimes the measures led directly to the misfortunes they were designed to avert. It soon became clear that it was impossible to deal effectively with the epidemic in the absence of help from the people themselves, and a policy of persuasion and assistance was substituted for the more rigorous measures, but this also failed to prevent the extension of the disease. In the meantime considerable progress had been made in the study of the epidemiology of the disease, and it was felt that if the remaining gaps in our knowledge could be filled greater precision might be given to the measures which it was possible to adopt. To this end the Government of India in the autumn of 1904 addressed the Right Honourable the Secretary of State for India with a view to undertaking a more complete enquiry into the etiology of plague, and a Plague Research Commission was established, working under the direction of an Advisory Committee in England. As a result of the establishment of this Commission by May, 1907, satisfactory replies had been found to most of the questions concerning the epidemiology and mode of spread of the disease. In the meantime the value of anti-plague inoculation had been conclusively proved, and in August, 1907, the Government of India were able to make definite recommendations relating to the following subjects: (1) the prevention of contact between man and infected rats and rat fleas, (2) the destruction of rats, (3) other measures for excluding rats from dwellings and for limiting their numbers, (4) evacuation of areas in which plague is prevalent, (5) provision of facilities for inoculation, (6) measures for the extirpation of plague from localities in which it persists throughout the period of abatement, and for preventing its spread from them. After a brief interval, the Commission resumed its labours, and at the present time the services of five specially trained officers are entirely devoted to the further study of important problems in connexion with the epidemiology and mode of persistence of the epidemic. The preventive measures that are at present being taken against the disease are based upon the findings of the Commission and are known to be those which alone can prove effective; but, as their success depends entirely upon the extent to which they find favour with the people, the results in different parts of the country are by no means uniform.

Detailed accounts of these preventive measures will be found in the annual reports of the several Provincial Sanitary Commissioners and only a few remarks upon them need be made here. In Madras, measures of rat destruction, evacuation of infected areas and inoculation are supplemented by measures for the segregation of patients and contacts, the disinfection of infected houses and effects, and the surveillance for seven days of persons coming from infected areas. In Bombay, inoculation, evacuation and rat destruction are the chief operations carried out. In Bengal, evacuation is the most popular of all measures. In the United Provinces, evacuation is not unpopular in rural areas and the inhabitants of towns sometimes agree to adopt it, but the people are averse to inoculation. It is believed, however, that, if their confidence can be gained by treating them for ordinary diseases, their prejudices against inoculation may in time be overcome, and to this end a number of travelling dispensaries have recently been established; four officers of the Indian Medical Service and 32 sub-assistant surgeons being employed on this duty. In the Punjab a similar system of travelling dispensaries has been in existence since 1907 and it is reported that inoculation is gradually coming into favour. In this Province evacuation is unpopular. Rat destruction is carried out in places where plague persists during the quiescent season and in other places as soon as the disease appears. In Burma the measures advocated at the close of 1910 were evacuation of small towns and villages, inoculation of those who would accept it, and the systematic trapping of rats. In some towns strenuous efforts for the destruction of rats by a method known as "driving" have been adopted, but it is said that the plan leads to large recurrent expenditure and is only a temporary expedient.

4. Since 1908-09 a recurring grant of 30 lakhs of rupees has been made from Imperial revenues for improving sanitation in the different Provinces with special reference to plague, and in 1910-11 a special non-recurring grant of 57 lakhs was made from Imperial revenues for expenditure chiefly on drainage schemes likely to improve malarial conditions in towns. It is hoped to discuss schemes of urban sanitation at a conference of Sanitary Commissioners which will be held in Bombay in November of this year.

5. Included in the non-recurring grant just mentioned is a sum of five lakhs of rupees which has been set aside as a special fund to be devoted to research in connexion with sanitation, and some of the suggested methods of utilising this grant in connexion with malaria and plague will be found on pages 1 and 7 to 9 of "Paludism" No. 3. It

is proposed that one of the objects of expenditure shall be the investigation and carrying out of various methods by which the people of India may be educated in subjects of elementary hygiene and domestic sanitation and in a knowledge of how best to prevent themselves from being attacked by malaria, plague, and other epidemic diseases. It is felt that although the very important discoveries and the vigorous prophylactic efforts that have been made in India have resulted in a very accurate knowledge of the measures necessary for the control of malaria and of plague, even a modicum of success in effective prevention cannot be hoped for unless the people themselves are willing to co-operate whole-heartedly in the campaign. It is thought that this active co-operation will not be secured until the people have learnt to understand and to have faith in the principles on which the measures are based, and that their education in these matters is a primary and essential condition of success. In this connexion it should be borne in mind that the history of epidemic plague as it occurs among human beings is this. Plague occurs among rats in a house. So soon as rats begin to die they at once migrate from the infected spots. The rats having been attacked by plague migrate from the house, but they leave behind them their nests, and in their nests they leave a large number of rat fleas which contain plague bacilli owing to their having sucked blood of infected rats. The rat flea ordinarily will not bite human beings, but when it becomes hungry it thinks a human being is better than nothing: it comes out and bites human beings and they become attacked by plague. The question of the prevention of plague is therefore chiefly one of domestic hygiene, and one way to prevent plague is by teaching the public that they should not allow collections of rubbish about their houses, behind which rats can build their nests. They should be taught also not to throw about in the vicinity of their houses remnants of food which will attract rats, and in fact every precaution should be taken to prevent the rat from becoming a domestic animal. The rat is not a domestic animal in the houses of Europeans but it is a domestic animal in the houses of a large number of Indians. What is wanted is to educate Indians up to this particular point. As regards malaria, reference is invited to the speech by the Honourable Maulvi Alli Choudhuri at the Imperial Malaria Conference in which he said "whatever measures might be adopted, the best and never-failing method will be to educate the people. It is absolutely necessary to educate the young and the old on this subject by means of lessons introduced in the school books and by leaflets, health series and popular lectures."

Just as in the case of plague the co-operation of the people is necessary for the eradication of the disease, so it may be pointed out that the attempts of Government to stamp out malaria are frequently nullified, owing to the fact that individuals persist in allowing old pots, gurrals, kerosine-oil tins, &c., to accumulate in their compounds and thus furnish breeding-places for mosquitoes. If our campaign against malaria is ever to be crowned by success, it is essential that the efforts of Government should be supplemented by individual endeavours to secure sanitation in and around the household.

This matter has engaged the serious attention of the Indian Branch of the St. John Ambulance Association, which has now inaugurated a series of lectures in "Home Hygiene" with special reference to tropical conditions. An advanced manual has already been published and a simple primer, which will be translated into the various vernaculars, is now under preparation.

(Signed) C. P. LUKIS.

No. 8.

Note by the Sanitary Commissioner with the Government of India, dated 5th March, 1912.

Sanitary Measures taken during the Year 1911-12.

A memorandum by Surgeon-General Lukis was laid on the table in September last, giving a full account of the measures taken up to that time for the eradication of plague and malaria in India.

The following additional information may be of interest to the Council.

(a) *Malaria.*

(1) A special malarial board has been constituted in Madras, and the Secretary of State has sanctioned the employment for three years, on malarial work, of a specially trained medical officer and an Assistant Surgeon, in addition to the staff employed by the local Government. Captain Horne, I.M.S., has been selected for this purpose.

(2) Sanction has been accorded to the extension of the deputation of the special malarial officers in Burma and the United Provinces for further periods of one and two years, respectively.

(3) Modifications have been made in the method of selecting officers to attend the malaria classes at Amritsar. Under the new arrangements it will be possible for any officer, who is seriously desirous of studying malaria, to gain admission. The class has also been enlarged so as to include both military medical officers and those in civil employ, and 32 officers have been selected to attend the class which will be held this month.

(4) The second Malaria Conference was convened at Bombay in November last and the proceedings have been published in the Annual Report of the Sanitary Commissioner with the Government of India for 1910. This Conference unanimously passed a series of resolutions pointing out the importance of instituting anti-mosquito measures wherever practicable in addition to making free use of quinine both for purposes of prophylaxis and treatment.

The Government have decided that the observations of Majors Liston and Christophers and of Dr. Bentley have shown that these measures may not prove as impossible a task as was formerly supposed, and it is proposed therefore to carry out anti-malarial operations in certain selected towns where a careful malarial survey has shown that the problem is one capable of practical solution.

(5) Experiments are being carried out in several of our large hospitals with a view to deciding what is the best preparation of quinine for general use and also the most efficient method of administration so as to obtain the full therapeutic effect. In addition to this, allotments of 3 lakhs in each case have been made for the formation of a reserve stock of quinine in Bengal and Madras.

(b) *Plague.*

(1) The Plague Advisory Committee continued its useful work under the direction in India of Major Liston. Two additional officers have been placed at the disposal of the Committee to carry out further observation on local immunity in Madras and the United Provinces, and in the laboratory at Parel important experiments are being carried out with a view to solving the difficult problem of the disinfection of gram bags without damage to their contents.

(2) Dr. G. F. Petrie was deputed to investigate the outbreak of Pneumonic Plague in Manchuria and his reports are now under consideration.

(3) A system of travelling dispensaries has been introduced into the United Provinces with the very best results. This system is an extension of, and improvement upon, that which has existed in the Punjab since 1907.

(c) *Yellow Fever.*

In view of the danger which will arise with the opening of the Panama Canal in 1913, Major James has been deputed to the endemic area of yellow fever to study the disease and to formulate a scheme for preventing its introduction into India. In the meantime, local Governments are being addressed with a view to instituting a careful mosquito survey in order that we may have accurate information as regards the distribution at the various ports of the particular mosquito which is known to be the carrier of the disease in the West Indies.

(d) *Sleeping Sickness.*

In view of the possibility that this disease may be introduced into India from Africa, rules have been framed for the examination of suspected vessels and persons arriving from the East Coast of Africa, and a notification is about to issue prohibiting the importation of antelopes from Africa. Advantage has also been taken of the return of Captain Mackie from the Sleeping Sickness Commission to obtain the sanction of the Royal Society to the publishing of a pamphlet in popular form giving full information as to the present state of our knowledge of this disease. The pamphlet is now in the press and will be published shortly.

(e) *General Sanitation.*

Septic Tanks.—This is a great difficulty in India. The data on which sanitarians work in England are of little use in India, owing to the fact that we have here to deal with a population who are largely vegetarians. Excellent experimental work has already been carried out in Bengal by Major Clemesha and in Dacca by Captain Gourlay, and an experimental installation on a large scale has now been inaugurated at Poona under

Captain Hutchinson, I.M.S. It is hoped that as the result of these experiments, reliable data for the designing and efficient working of installations for disposal of sewage by the bacterial method in this country will be available by the end of the year.

(f) *Infant Mortality.*

This important subject was discussed at the first Sanitary Conference. In addition to this the Government of India deputed Major Greig as their representative at the Congress for the protection of infants at the breast which met at Berlin in September, 1911. His report, together with a number of important papers and publications, dealing with the problem of infant protection is now under examination and investigation.

(g) *Development of Research Institutes.*

Under this head come the grants for the development of the Central Research Institute at Kasauli and the Bombay Bacteriological Laboratory at Parel, and for the construction of a Bacteriological Laboratory in Burma.

At Kasauli it is proposed to constitute a separate Serum and Vaccine Department in order to meet the growing demand for curative sera of all kinds, and also to create three separate bureaux—one for general epidemiological research, one for protozoology and one for malaria.

At Parel it is intended to enlarge and improve the present laboratories so as to fit them for teaching purposes, with a view to the institution of post-graduate classes such as are now held at Kasauli. These laboratories will, it is hoped, ultimately form part of a school of Tropical Medicine to be established in connexion with the King Edward Memorial Hospital which is to be built in close proximity to the Parel laboratory.

(h) *The Tropical School of Medicine at Calcutta.*

This grant is intended to cover the construction of laboratories and research rooms for this school which will be worked in connexion with the Calcutta Medical College and which will be open to all qualified practitioners for post-graduate study. The Government of India has also agreed to meet the recurring charges for the additional teaching staff. In connexion with this school it is hoped that the Calcutta University will institute a Diploma in Tropical Medicine, similar to those granted at Liverpool and Greenwich.

(i) *The Indian Research Fund.*

The first meeting of the Scientific Advisory Body was held at Bombay on November 15th, 1911, when it was decided—

- (a) to defray the cost of Major James' deputation to the endemic area of Yellow Fever,
- (b) to make certain grants for the purchase of scientific literature,
- (c) to start a fresh series of investigations into the problems connected with Cholera and Kala Azar,
- (d) to formulate proposals for the co-ordination of work on medical entomology,
- (e) to form a Committee to enquire into the present method of registering vital statistics and to study the causes of decrease in population—also to consider the important questions of Town-planning and of Popular Hygienic education and Propagandism.

The enquiry into Kala Azar has already commenced. The Madras Government has deputed Captain Patton for a period of six months to work on this subject in Royapuram and its neighbourhood, and the Research Fund are appointing for the same purpose Captain Mackie (who has recently returned from the Sleeping Sickness Commission), and are associating with him an Indian gentleman, Dr. Korke, who has been specially trained under Sir Ronald Ross at the Liverpool School of Tropical Medicine. Captain Mackie will probably work in Assam, and the general lines of the investigation have been worked out by a Committee consisting of Surgeon-General Bannerman, Major Christophers and Dr. Bentley.

The Cholera investigation will also start immediately, the two workers detailed for this being Major Greig and Captain Gloster, whilst the details of the investigation have been worked out by Sir David Semple and Major Leonard Rogers, whose work in connexion with Cholera is so well known.

The report of the provisional committee on the study of Medical Entomology has been received and is now under consideration.

(Signed) C. P. LUKIS.

No. 9.

Letter from the Government of India to the Secretary of State for India, No. 178, Finance (Accounts and Finance Funds), dated 20th July, 1911.

We have the honour to refer to the correspondence ending with your telegram* dated the 7th March, 1911, in which your Lordship approved of our proposal to set aside a sum of 5 lakhs, out of the grant of 10 lakhs to the Government of the Punjab for expenditure on sanitary works, as an endowment for research in connexion with the Central Research Institute, Kasauli.

2. We trust that this amount will be supplemented by wealthy and public spirited persons in India and that it may eventually form the nucleus of a fund for an extensive campaign of scientific research in tropical diseases. In that case it may be necessary to form a regular Trust for its administration under the Charitable Endowments Act (Act VI. of 1890). For the present as it is only a case of a grant being made from one department to another, no question of a Trust can, we are advised, arise. We propose to treat the grant somewhat in the form in which we treat the Amir's subsidy and to open a separate ledger account under Article 355 and in accordance with form 42 of the Civil Accounts Code, Volume I. A Memorandum of Association, a copy of which we enclose for your Lordship's information, will explain the object for which the fund is intended and the constitution of its Governing Body. The detailed procedure in dealing with the fund will be as follows :—

- (i.) The sum of 5 lakhs will be transferred by debit against the head 24—Medical in the Punjab books to a personal ledger account to be opened in the name of the President of the Association for the administration of the fund.
- (ii.) The Accountant General, Punjab, will be authorised to place any amount at the credit of this account as a fixed or current deposit with any Presidency Bank as may, from time to time, be directed by the President.
- (iii.) Any interest accruing from the investment as well as any other receipt from subscriptions, &c., or the proceeds of any investment when realised will be credited to the account, while any amounts withdrawn for investment and any current expenditure to be incurred under the President's orders will be debited to it.

3. The proposed special account will, as explained above, deal not only with the 5 lakhs grant—the expenditure from it and the receipts from its investment—but will also include receipts from subscriptions and donations to the fund from the outside public until such time as they are on a scale to necessitate the constitution of the Trust. We trust that these proposals will meet with your Lordship's approval and we shall be glad if orders on the subject can be communicated to us at an early date. We desire to depute an officer shortly to inquire into the causes of "Yellow Fever" in the area in which it is endemic in view of the danger to which the East will be exposed by the opening of the Panama Canal. About this we shall address a separate communication to your Lordship.

We have, &c.,

(Signed) HARDINGE OF PENSHURST.
O'M. CREAGH.
G. FLEETWOOD WILSON.
J. L. JENKINS.
R. W. CARLYLE.
S. H. BUTLER.
S. A. IMAM.
W. H. CLARK.

Enclosure in No. 9.

Memorandum of Association.

- 1 The name of the Association is "The Indian Research Fund Association."
2. The object for which the Association is established is the prosecution of research and the propagation of knowledge, in connexion with :—
 - (a) the cause and mode of spread of epidemic diseases ;
 - (b) the prevention of epidemic diseases by direct attack upon the casual micro-organisms.

3. The Governing Body of the Association is constituted as follows :—

The Honourable Member of Council of the Government of India in the Education Department.	} President.
The Secretary to the Government of India, Education Department.	
The Director-General, Indian Medical Service.	} Members.
The Sanitary Commissioner with the Government of India.	
The Director, Central Research Institute, Kasauli.	
Major S. P. James, I.M.S.	
Major S. R. Christophers, I.M.S.	

No. 10.

Despatch from the Secretary of State for India to the Government of India, Revenue, No. 97, dated 22nd September, 1911.

Having considered in Council the letter of Your Excellency's Government in the Finance Department, No. 178, of the 20th July last, I sanction the proposals therein contained for the investment and administration of the sum of 5 lakhs, the grant of which as an endowment for research in connexion with the Central Research Institute, Kasauli, was sanctioned in my telegram of the 21st March last.

I have, &c.,
(Signed) CREWE.

No. 11.

Letter from the Government of India to the Secretary of State for India, No. 12, Education (Sanitary), dated 22nd August, 1912.

In compliance with the request contained in Your Lordship's telegram* dated the 1st August, 1912, we have the honour to forward for presentation to Parliament a copy of the papers noted in the attached list of Enclosures.

2. In addition to our letter to local Governments on the subject of general town planning and the resolution regarding the appointment of the Sanitary Commissioner with the Government of India mentioned in your telegram, we have included certain other communications to local Governments regarding the opening out of congested areas, the measures necessary in urban areas for checking tuberculosis, the utility of travelling dispensaries and the rules of the Indian Research Fund Association.

We have, &c.,
(Signed) HARDINGE OF PENSHURST.
O'MOORE CREAGH.
R. W. CARLYLE.
HARCOURT BUTLER.
SYED ALI IMAM.
W. H. CLARK.
R. W. GILLAN.

List of Enclosures.

1. Circular letter to local Governments and Administrations regarding general town planning; No. 1345-54, dated the 26th July, 1912, and Enclosures.
2. Circular letter to local Governments and Administrations regarding the opening out of congested areas in existing towns, No. 1480-1488, dated the 9th August, 1912.
3. Circular letter to local Governments and Administrations regarding the measures necessary for checking tuberculosis in urban areas and the utility of travelling dispensaries, No. 1462-72, dated the 9th August, 1912, and Enclosure.
4. Circular letter to local Governments and Administrations, No. 90-105, dated the 8th July, 1912, and Rules of the Research Fund Association.

* Not printed.

5. Resolution regarding the appointment and duties of the Sanitary Commissioner with the Government of India, No. 1524-1547, dated the 19th August, 1912, and Annexure.

Enclosure 1 in No. 11.

From the Secretary to the Government of India (Education Department), Nos. 1345/1354, dated 20th July, 1912, to the Chief Secretary to the Government of Madras; the Secretary to the Government of Bengal, Municipal (Sanitation) Department; the Secretary to the Government of the United Provinces, Sanitation Department; the Revenue Secretary to the Government of the Punjab; the Secretary to the Government of Burma, General Department; the Secretary to the Government of Bihar and Orissa, Municipal Department; the Honourable the Chief Commissioner of the Central Provinces; the Honourable the Chief Commissioner of Assam; the Honourable the Chief Commissioner and Agent to the Governor-General in the North-West Frontier Province.

WITH reference to the letter from the Department of Education, No. $\frac{461}{463, \&c.}$, dated the 27th March, 1912, I am directed to No. 467 (to Bihar and Orissa and) to Assam.

address $\left\{ \begin{array}{l} \text{the Government of } \frac{\text{Madras}}{\text{Bengal}} \\ \text{---} \\ \text{---} \end{array} \right\}$ on the
you $\frac{\&c.}{\&c.}$

question of general town planning which was one of the subjects discussed at the Sanitary Conference, Bombay.

2. The Government of India are of opinion that the question is one of great and increasing importance. The great majority of large Indian towns are surrounded by insanitary quarters which have been permitted to grow up without any attempt at control and which are often the starting grounds of plague and other diseases. A large population is crammed into an altogether inadequate space, and owing to the growing tendency of suburban landlords to refuse to let agricultural land for building purposes it is becoming more and more difficult to meet the increasing demand among large classes of the population for improved dwellings amid more sanitary surroundings.

3. The art of town-planning is of comparatively modern growth, and it is only recently that town-planning experts have arisen, in very small numbers even in Europe. The matter is, therefore, one in which progress must necessarily be slow, but the Government of India are of opinion that a beginning can be made by enquiries as to the necessity for town-planning legislation, and the form which such legislation should take.

4. The Government of India believe that they are right in stating that nowhere in India has the question taken a practical shape except in Bombay where a general Town Planning Act is under consideration. The question was discussed at the First All-India Sanitary Conference which was held at Bombay in November, 1911, and papers on the subject were read by Mr. Turner who attended the Conference as the delegate of the Government of Bombay. A copy of these papers which were published as appendices to the report of the Conference are enclosed together with a memorandum suggesting the main lines on which an Act might be drawn up.

5. The suggestions in the memorandum are based mainly on the provisions of the English Housing and Town Planning Act of 1909, and the proposals for re-distribution (pooling of land of small owners and redistributing it in suitable building plots, less the portion required by the Municipal authority for road and open spaces and other public purposes) are taken from the German Act. Some such power appears to be necessary when planning building plots on land with diversified ownership as is peculiarly the case in India. In practice the major number of alterations would consist in clipping or adding small strips to the boundaries of existing holdings, or in joining two or more small contiguous holdings so as to make a plot of suitable size for building. Mr. Turner's papers, to which special attention is invited, explain in detail the development contribution scheme, re-distribution and consequent transfer of rights. The principal feature of the scheme is that its whole cost is apportioned and recovered from the various persons and interests concerned in the shape of a development contribution calculated in proportion to the increased value which is estimated to accrue, on the completion of the

scheme, to each re-allotted plot ; that it thus obviates, as far as possible, the necessity for raising capital, and secures for public purposes a share in the profits of the transaction.

6. The question of town-planning so far as it affects Indian cities appears to the Government of India to need examination from the following points of view, viz. :—

(a) The extension of existing towns.

(b) The improvement and opening out of existing insanitary areas in old towns.

The present reference deals mainly with the situation which is likely to be created by (a) and the Government of India propose to address local Governments shortly on the question of strengthening the existing powers of local authorities in dealing with existing insanitary areas. Where land on the outskirts of a town is mainly agricultural land and can be acquired cheaply *en bloc* it appears to the Government of India that the better policy would be for the local authority to purchase it outright and secure a return by premium and ground rents as buildings extend instead of depending on development taxes. But where an existing city has been allowed to grow up in a haphazard way with vested interests in its surroundings, the acquisition of land would of necessity be of a much more expensive and difficult character, owing to delays in litigation and the rise in prices of land. It is in such cases that it appears to the Government of India that control would be preferable to acquisition, which indeed for financial reasons would, on a large scale, be impossible. The object of the suggestions now made is to render it possible to control future urban development and to provide for the expansion of population without imposing increasing burdens on the general revenues or the resources of local bodies such as are at present involved when urban land can be acquired only under the Land Acquisition Act.

7. The matter is, however, novel and complicated and the Government of India will be glad if it is fully and carefully considered and they are favoured with

{ the mature opinion of	<u>His Excellency the Governor in Council</u>	} as to (whether local
	<u>His Honour the Lieutenant-Governor</u>	
your mature opinion		

Not to Bombay. () to local Governments only. which have a local Council. [] to Central Provinces, Assam, Coorg and North-West Frontier Province.	legislation is possible or whether it is desirable to have an All-India Act on the subject). [whether an All-India Act on the subject is desirable].
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They will also be glad to receive any suggestions on the scheme outlined in the revised memorandum, dated the 11th June, 1912, which

{ the Government of	<u>Madras</u>	} &c.
	<u>Bengal</u>	
you		

may be able to offer.

8. The question is one of considerable public interest and the Government of India will be glad to know whether in

{ the opinion of	<u>His Excellency the Governor in Council</u>	} &c.
	<u>His Honour the Lieutenant-Governor</u>	
your opinion		

it would be advisable to publish these papers at this stage, in order to elicit a general expression of opinion.

ANNEXURE 1 TO ENCLOSURE 1 IN No. 11.

NOTE ON REDISTRIBUTION OF PLOTS AND CALCULATION OF DEVELOPMENT TAX IN TOWN-PLANNING SCHEMES.

“Redistribution” may be defined as the pooling of plots of land belonging to different owners and the allotment to them, after making provision for lands required by the local authority, of plots reconstituted in more convenient form for building sites.

The reconstituted or allotted plots will all be provided with access on roads, either existing or proposed. The area for allotment of plots will be the original area included in the scheme diminished by the land taken for roads and other public purposes, so that, in general, the allotted plots will be of smaller area than their corresponding original plots. When roads are actually constructed an allotted plot will increase in value, and the amount of such increase measures the “unearned increment,” from which the costs of construction and other expenses of a scheme should be defrayed. The difference in value at any particular instant—such as at the date of a notification—between an original plot and its corresponding allotted plot, valued without reference to future improvements contemplated in a development scheme, represents a material contribution in land by the plot holder of which account must be taken in calculating the dues leviable. If the allotted plot as so valued is of less value than the corresponding original plot, the plot holder must be given credit

for the difference, and if of greater value, then the plot holder must be debited with the difference. In this way, credit is given for the value of any land taken from an original plot ; and debit is made for the value of any land added to it. No cash on this account passes between the holder and the local authority, but debit and credit are made against the holder's contribution for constructional and other expenses of the scheme. A holder's contribution share should be proportional to the amount of his "unearned increment," i.e., to the difference in values of his *allotted* plot, when valued without reference to future developments, and when valued on the assumption that the scheme has been completed. The former may be called the "undeveloped" value and the latter the "developed" value of the allotted plot. The developed value is only an estimate, it is true, but any slight error in the estimate will not affect a holder's pocket very materially unless the price of land is very high. The expenses of a scheme must include the net total difference in value between all the original plots and the undeveloped values of all the allotted plots, for this difference represents an immediate and material contribution in land to the scheme by the holders and its value should be shared by all in proportion to their "unearned" increments.

2. The above method of calculating the contribution share is *absolutely independent* of the system on which the reconstituted plots are allotted ; for every holder is given full credit for the present value of the land taken from him.

The German Act (Lex Adikes) lays down that plots should be allotted *as far as possible* in proportion to original ownership.

If the proportion refers to relative *areas* there is necessarily a large displacement of plots, that is to say, many of the allotted plots cannot be in the same position as the main portions of their corresponding original plots, and if the proportion refers to relative *values* it is often a hopeless puzzle to arrange so that the developed values of the majority of the allotted plots bear *inter se* anything like the same ratios as the values of the original plots bear to one another. Only in a homogeneous tract of undeveloped land is there a chance of successfully allotting plots bearing *inter se* as far as possible either given proportional areas or given proportional values.

For a successful redistribution the main portions of the allotted plots should be generally in the same positions as the main portions of their corresponding original plots or in other words plots should be displaced as little as possible. Whole plots included in land required for roads and other public purposes must be displaced, but other plots should keep their position as far as possible. No hard and fast rule need be laid down for the way in which the reconstituted plots should be allotted, but the allotment should be made in consultation with the holders and should be approved either by the holders of the major portion of the area considered or by a controlling authority or by both.

3. Simple *example* showing the above method for calculating the contribution share.
Three plots X, Y, Z are to be developed by the construction of a road costing 900 rupees, the costs of preparing the scheme being 100 rupees :

Plot.	Value of original plot.	VALUE OF ALLOTTED PLOT.		Unearned increment, 4—3.	Difference between columns 3 & 2.
		Undeveloped.	Developed.		
1	2	3	4	5	6
X	Rs. 100	Rs. 80	Rs. 200	Rs. 120	Rs. -20
Y	200	250	600	350	50
Z	300	250	350	100	-50
Total	600	580	1,150	570	-20

To find the dues leviable, upon X, credit must be given for Rs. 20 (column 2—column 3) and it must bear in proportion to its unearned increment (column 5) a share of the total expenses Rs. 1,000, and also a share of the net difference between the values of the original and undeveloped allotted plots, i.e., Rs. 20 (column 6). That is to say the contribution leviable on X is—

Rs.

the 50,000 rupees amongst all allotted plots in the proper proportion. But if it be only possible to construct roads each monsoon, to the extent of 10,000 rupees the scheme will take 4 years to complete and there is no need to raise more than 10,000 rupees each year for new roads. The 10,000 rupees to be met at once can be obtained by levying $\frac{1}{4}$ th full development tax on all allotted plots, and the 10,000 rupees required annually for new roads can be obtained by levying the full tax upon those allotted plots which front the roads constructed during the year. If the full tax levied upon such frontage plots is not sufficient to raise the 10,000 rupees required, the general tax of $\frac{1}{4}$ th can be increased and if the full tax on frontage plots exceeds the 10,000 rupees required, then the requisite proportion of the full tax need only be levied on the frontage plots, the levy of the difference being deferred until it is required. Even whilst paying the $\frac{1}{4}$ th development tax the holders are distinctly benefited, for they will all possess saleable plots suitable for building and upon which building will be allowed and will all have proper access to their plots over public land.

5. *Compensation by debentures.*—It may happen that a holder's share of expenses is less than the difference in value between his original and undeveloped allotted plot or in other words is less than the value of his contribution in land. In such a case instead of paying a development tax to the local authority the holder will have to be compensated. He can either be paid cash down, or be given a debenture guaranteeing him interest and sinking fund charges on the amount to be paid to him. The issue of such a debenture will reduce the capital to be raised in the open market. Full security, however, is present whether compensation is paid to such a holder either in cash or by debenture.

Example.—The contributions leviable from A, B, C, D are as follows :—

A	..	..	..	..	..	..	..	..	..	..	..	Rs. 500
B	..	..	..	..	..	..	..	..	..	..	..	600
C	..	..	..	..	..	..	..	..	..	..	..	—300
D	..	..	..	..	..	..	..	..	..	..	..	200
												1,000 net.

If C is compensated at once, a capital of Rs. 1,300 will have to be raised on the security of the amounts due from A, B, D. If C is compensated by debenture only 1,000 rupees capital would have to be raised in the open market, and interest and sinking fund charges would be collected from A, B, D as before on Rs. 1,300 by means of a development tax.

The system of payment by debentures is capable of extension, and some persons would possibly prefer being paid by a saleable debenture ensuring steady interest, instead of being paid cash down.

6. *Incidence of taxation.*—The development tax should be fixed for each allotted plot, so that when a plot is sold a purchaser will know exactly with what taxes the plot is burdened. Some holders may have several separate original plots and it may not be possible to allot a separate plot for each original plot. In such a case the total contribution of the holder can be calculated and distributed over his allotted plots in proportion to their unearned increments.

Example.—A holder has plots of the following value :—

Value of original plot.	Undeveloped value of allotted plot.	Developed value of allotted plot.	Unearned increment, 3—2.
1	2	3	4
Rs. 1,000 2,000 3,000 4,000	Rs. 2,000 4,000 2,000 —	Rs. 3,000 7,000 5,000 —	Rs. 1,000 3,000 3,000 —

If the holder's contribution is Rs. 700 then it will be divided amongst the allotted plots in the proportion of 1,000 : 3,000 : 3,000, *i.e.*, the burden on the plots will be Rs. 100, Rs. 300 and Rs. 300 respectively.

7. Formula for calculating contribution share :—

Let

- a_0 = Value of original plot.
- a = Undeveloped value of allotted plot.
- A = Developed value of allotted plot.
- X = Constructional and all expenses of the scheme debitable to holders other than the net compensation to be credited to holders for land surrendered. (*Vide* paragraph 1.)

The holder's contribution share is equal to—

$$(a - a_0) + \frac{A - a}{EA - Ea} [X + E(a_0 - a)]$$

where E is a symbol representing the sum total of the quantities of the type to which it is joined.

The fraction $\frac{X + E(a_0 - a)}{EA - Ea}$ forming a portion of the second member of the expression is easily calculated for any particular scheme, and remains constant in calculating the share of each and every holder. If we denote this fraction by K then the share is equal to $(a - a_0) + K(A - a)$ which simply means that a holder is given credit for the present value of the land he surrenders $(a - a_0)$, and pays the proportion K of his unearned increment $(A - a)$ towards the expenses of the scheme. The net total of all contributions is equal to X . If A and a are proportional to a_0 , that is to say, if the developed and undeveloped values of an allotted plot are each proportional to the value of the original plot then the contribution share is proportional to the value of the original plot, and if these proportions obtain in respect of all the plots then there is no need to value the allotted plots as undeveloped. In a small scheme therefore, such as the construction of a small accommodation road

where it may happen that all original plots are reduced at once in value in the same proportion, and when they all increase in value in the same proportion on completion of the scheme, the contribution shares can be found by dividing up expenses in proportion to the differences between the developed values of the allotted plots and the values of their corresponding original plots.

8. *Practical application* of this method of allotting plots and calculating the development tax has been made tentatively on paper to a large partially developed area, about one square mile at Santa Cruz, a suburb of Bombay. This scheme comprises the acquisition and construction of about 3 miles of roads of varying widths and 1 mile of sweepers' passages 10 feet wide. The public sites for acquisition comprise those for—

A Park,
Municipal Office,
Dispensary,
Girls' and Boys' Schools,
Police Station,
Market,
Lawn Tennis Ground,
Dharmasala,

and the existing roads are widened where necessary. After allowing for possible local fund and Government grants the net total cost of the scheme to be met by holders is estimated at Rs. 1,50,000. The capital to be raised is calculated at Rs. 1,52,000, the extra Rs. 2,000 representing compensation to be paid to those holders whose contribution in land is greater than their share of expenses (*vide* paragraph 5 above). The construction of roads will probably take five years to complete, and the initial expenses can be met and road construction started by the levy of 12 per cent. only of the full development tax. A holder's full contribution in land and cash together is found to be about $\frac{1}{3}$ rd or less of the present value of his original plot, and the ratio of such contribution to the increase in the value of his holding, *i.e.*, to the difference between the developed value of his allotted plot and the value of his original plot, is found not to exceed 60 per cent. In most cases it is much less.

9. In conclusion it must be stated that the method of calculation described in this note has not yet been sanctioned. A Town-planning Bill has not yet been brought forward in the Bombay Legislative Council. Many methods of calculation have been tried on paper, but the method above described is the one which in my humble opinion is practical, and provides an *absolutely equitable system* of distributing expenses.

(Signed) E. G. TURNER, I.C.S.,
Special Officer, Salsette Building Sites.

ANNEXURE 2 TO ENCLOSURE 1 IN No. 11.

Transfer of Rights.

I think that if a holder and other persons interested in a plot come to an agreement in respect of their rights in the allotted plot, the arbitrator should be bound to accept such agreement unless its terms are prejudicial to the objects of planning. It should also be open to a holder to demand that a lease to cultivate should not be transferred. The holder will then be in a position to use his plot to building purposes, and he will naturally be charged with the cost of determining the lease. Again, a cultivating tenant should be able to claim that his lease should determine in cases where the land of the allotted plot is not of the same agricultural kind as that of the original plot. A cultivating tenant of a rice field should have the option of refusing to have his lease transferred to an allotted plot consisting of a garden, land, or a mango grove.

4. *Leases—*

If a lease is extinguished or modified it is clear that compensation must be paid to the Lessee. Take the case of the Government acquiring Land for a road under the Land Acquisition Act. An owner would be paid the market value of the land taken and the lessee would be paid for the loss caused by having a portion of his leased land taken from him. The lessee would also demand to pay less rent to the owner or be further compensated if he is compelled to pay the old rent in the future. In the latter case the owner would have to pay the compensation to the lessee, for he would be receiving rent for land that had been bought from him by Government. The remaining compensation payable to the tenant would be borne by Government.

Example.

A is the owner of 1 acre of homogeneous cultivable land leased to B at a yearly rental of Rs. 60 and the lease has 5 years to run. Government acquires under the Land Acquisition Act one-tenth acre of this land for a road. Let the market value of the holding be Rs. 600. A would be awarded the market value of one-tenth acre, *i.e.*, 60 rupees and would in future be entitled to receive only Rs. 54 rent from B. If, however, no alteration in rent is made and A continues to receive the rent of Rs. 60, then B must be given as compensation the present value of Rs. 6 a year payable for 5 years, and the market value payable to A must be reduced by that amount. When a portion of a leased plot is taken for a road under the Land Acquisition Act, the tenant retains his right on the remainder of the plot. Now, as the price of land rises on the construction of a road, it will generally pay the owner to get rid of his tenant and utilize or sell his land for building purposes. In order to do this, the owner would have to pay out the tenant at his own expense. If, therefore, the Town-planning Act gets this done for him it is only right that he should be debited with its cost. The cost of extinguishing a lease therefore should be debited to the Town-planning scheme and the owner of the original plot in such proportion as the arbitrator may determine in reference to the portion of the *original* plot taken by the local authority and the remaining portion of the original plot (*vide* section 15, *Lex Adikes*).

Example.

In example 1 the cost of compensating B extinguishing his lease would be borne by the scheme and the owner in the proportion of 1 to 9.

If a whole plot is taken for public purposes and no reconstituted plot can be allotted, then the whole cost of extinguishing a lease would be a cost of the scheme. If no portion of a plot is taken for public purposes then the whole expense of compensating a tenant for a lease that must be extinguished would fall on the owner.

On redistribution day all leases on original plots determine, and some leases—either in their original or in a modified form—are imposed on the allotted plot. The loss to the lessee by the transfer can be calculated by the arbitrator. The portion of this loss debitable to the scheme is calculated as stated above in reference to the portion of the *original* plot taken by the local authority and the remaining portion of the original plot. The remaining portion of the lessee's loss must be borne by the owner.

Example.

In example 1 the arbitrator calculates that :—

(a) the loss to the lessee by transference to the allotted plot is Rs. 60 ;

(b) The cost to the scheme by extinguishing the lease of the original plot is Rs. 10.

The owner will therefore be debited with Rs. 50 (60 less 10) as his share of compensation towards the loss sustained by the lessee.

It may happen that a lessee gains by having his lease transferred *in toto* to an allotted plot, *i.e.*, an allotted plot may be simply the original plot slightly enlarged so as to round it off. In such a case the arbitrator could either increase the rent payable by the lessee or allow the lessee rights over a portion only of the allotted plot.

Mortgage without possession.

5. If the present value of an allotted plot with reference to the improvements contemplated is of greater value than the original plot, the mortgage can be transferred without loss of security. If a scheme is to be successful this will usually be the case. It may, however, happen that an allotted plot as valued above is less than the value of the original plot. If the mortgagee accepts the allotted plot as his new security then all is well, but if he does not then the whole or any part of the difference in values between the original plot and the allotted plot (valued as undeveloped) instead of being credited to the holder, should be paid to the mortgagee in whole or part satisfaction of the mortgage.

Example.

	Rs.
(a) Value of original plot	300
(b) Amount due on mortgage	200
(c) Undeveloped value of allotted plot	100
(d) Present value of allotted plot in reference to improvements contemplated	150

Instead of crediting the holder with Rs. 200 (a)—(c) it may either be paid to the mortgagee and the mortgage thereby redeemed, or the holder may be credited with Rs. 150 only instead of 200 rupees and Rs. 50 each could be given to the mortgagee and his mortgage transferred to the allotted plot.

Mortgage with possession.

6. These are usually either one or other of the following two kinds :—

(a) The use of the land is given to the mortgagee for a certain number of years in full repayment of the mortgage.

(b) The mortgagee holds the land and reaps the profits on it by way of interest on his loan.

Case (a) is precisely similar to a lease by the mortgagor to the mortgagee for a definite number of years and can be treated in the same way.

Case (b). The mortgagee will be satisfied if he gets at least equal security and an equivalent for the secured profits. Equal security can be given as in the case of a mortgagee without possession, but the mortgagee may not in all cases be able to utilize the allotted plot so as to secure him the same profits as the original plot yielded. For any such loss of profits he is entitled to some equivalent at mortgagor's cost and for any increase of profits the mortgagor entitled to credit. A rocky piece of ground allotted in lieu of a cultivable plot will not always be of use to a mortgagee in possession, for even if the mortgagor consents to the mortgagee erecting buildings on the rocky land it may not pay the mortgagee to erect a substantial structure and the scheme may not permit of huts being erected. The best course in such a case would be to compensate the mortgagee at the mortgagor's expense for loss of possession and to put the holder (mortgagor) in possession of the allotted plot, thereby converting the mortgage with possession into a mortgage without possession. Any amount paid to the mortgagee would go in part satisfaction of the mortgage. In cases of difficulty the original plot should be bought up and allotted to others.

7. In cases where a plot is heavily encumbered it may happen that the nett total liability on an allotted plot may exceed the development value of the allotted plot.

Example.

	Rs.
(a) Value of original plot	1,000
(b) Undeveloped value of allotted plot	800
(c) Developed value of allotted plot	900
(d) Proportion of "unearned increment" demanded for expenses	—
(e) Cost debitable to holder for extinguishing or transferring rights in his original plot	1,100

The total liability of the allotted plot is therefore $1,100 - 200 + \frac{1}{3} (900 - 800) = 900 + 33\frac{1}{3} = 933\frac{1}{3}$.

In such a case the holder should be given the option of paying 33 rupees cash down—thereby giving the local authority full security for the development tax, or his original plot should be bought up and allotted to others.

If the net liability of a reconstituted plot exceeds its developed value, such plot should not be allotted unless the holder of the corresponding original plot pays such excess to the local authority for credit to the scheme. On failure to pay such excess within a specified time the whole of the

original plot shall be liable to be acquired for the local authority at the value fixed by the arbitrator, and the reconstituted plot shall be allotted to the local authority. The cost of acquiring such portion of the original plot as may not be taken for public purposes shall not be a cost of the scheme.

(Signed) E. G. TURNER, *I.C.S.*,
Salsette.

ANNEXURE 3 TO ENCLOSURE 1 IN No. 11.

SHORT NOTE ON TOWN-PLANNING IN SALSETTE ISLAND.

The Bombay Government propose to introduce shortly a Town-planning Act for developing the Bombay suburbs in Salsette Island which adjoins Bombay on the north. Details of town-planning schemes are being worked out by a special officer deputed for the purpose and the method being followed is similar to that contained in the German Act, the *Lex Adikes*, whose principal virtues lie in obviating as far as possible the necessity of raising capital and in providing for the redistribution of existing plots so as to render them more suitable for building purposes.

The method briefly described is as follows :—

All land within the area being planned is pooled and the local authority takes all land required for roads, markets and other public sites and the remaining land is divided into suitable building plots and allotted to the original holders. The allotted plots are distributed, as far as possible, in the same proportion as the original ownership. The main portions of the allotted plots are kept, as far as possible, in the same position as the original plots so as to reduce displacements of existing holdings to a minimum. All rights in the original plots are transferred, where possible, to the allotted plots and in other cases are extinguished by cash compensation or otherwise. All expenses incidental to redistribution and all costs of constructing roads and other works included in a scheme are obtained by a loan. Interest and sinking fund charges are met by the levy of a development tax upon owners in proportion to the individual benefits derived from the operation of the scheme. The benefit derived is found by estimating the "unearned increment" accruing to each holding on completion of the scheme. The estimate is liable to a certain amount of error, but, where the price of land is not too high, a slight error will not affect very materially the pockets of the holders.

2. The method above described may be applied to large or small schemes and to large or small areas. It can be applied to the construction of a single road or even to the mere rearrangement of plots neighbouring an existing road, and it may be applied to a large area for the purpose of acquiring all land required for public purposes. The method has been worked out on paper for an area of about one square mile at Santa Cruz, a suburb on the Bombay, Baroda and Central India Railway about 12 miles from the Fort, Bombay, and a scheme has been tentatively drawn up which provides for the redistribution of plots, the construction of roads and provision of lands for a park, a dispensary, a municipal office, schools, a police station and a recreation ground. The individual cost in most cases in land and cash for all these benefits is estimated to be under 30 per cent. of the present undeveloped value of a holding. A small scheme, such as the construction of a single road, can be carried out in a year, and the whole development tax can be at once levied from all holders, but for a large scheme, where some years may elapse before all constructional works are completed, a portion of the tax need only be required from owners until those works which materially better their holdings are taken in hand.

(Signed) E. G. TURNER, *I.C.S.*,
Special Officer, Salsette Building Sites.

ANNEXURE 4 TO ENCLOSURE 1 IN No. 11.

MEMORANDUM.

The general principle of a town-planning scheme is that a scheme is prepared for a given area, distributing the land with which it is concerned to such and such uses, this scheme is notified and discussed and settled, and after it is settled the owners are bound to conform to it. The following suggestions indicate generally the lines which legislation might follow.

1. A Town-planning Act to be enacted, capable of extensions to any given area by order of the Local Government.

2. A local authority to be constituted for such area with power to make a town-planning scheme. Such local authority to be appointed by the Local Government. This local authority to be subject to a controlling authority, similarly appointed.

3. The local authority to be empowered to declare by notification, in the manner prescribed, its intention to make a town-planning scheme for the whole or any part of such area; the notification to be accompanied by such general plans and information as may be prescribed by rules.

Such declaration to be made, with the previous sanction of the Local Government, either *suo motu*, or by order of the controlling authority.

4. The scheme to provide for any or all of the matters referred to in the schedule to the Act and such other matters not inconsistent with the purposes of the Act as may be prescribed, and to be accompanied by such plans and estimates as may be prescribed by rules under the Act. Such matters would be the construction, diversion and alteration of roads and communications, the construction and alteration of buildings, bridges and other structures, the plotting out of land as building sites, whether intended for building in the immediate future or not; the reservation of land for open spaces, gardens, recreation grounds, schools, markets and public purposes of all sorts; drainage, lighting and water supply, the preservation of objects of historical interest or natural beauty, prescriptions as regards the number and nature of buildings allowed in specified areas and the purposes to which specified areas may or may not be appropriated.

5. The scheme to apply to land which is or is likely to be used for building purposes. Land

likely to be used for building purposes to include any land likely to be used for the purpose of providing open spaces, roads, streets, parks, or for the purpose of executing any work upon or under the land incidental to a town-planning scheme. The scheme to be capable of extension to a piece of

Cf. section 54 (f). Housing and Town-planning Bill.

land not likely to be used for building purposes, which is so situated with regard to any land likely to be used for building purposes that in the opinion of the controlling authority it ought to be so included and the controlling authority to be authorised to include in the scheme provisions for the demolition or alteration of any buildings thereon as far as they may be necessary to carry the scheme into effect.

6. Within a period to be prescribed of the notification of the declaration to make a town-planning scheme the local authority, with the approval of the controlling authority, and in default of the local authority the controlling authority, to publish a block scheme and plan for the area included in such declaration.

7. *Contents of scheme.*—Power to be given to prescribe generally by rules under the Act the information to be contained in the block scheme, and the plans and estimates to accompany it. In particular to prescribe that the scheme should specify the restrictions to be imposed on the number of buildings to be erected on a given area, and the height and character of those buildings, and should contain estimates of the cost of the scheme; total of development contribution to be distributed over the area left with, or allotted under redistribution, to the owner; and other details necessary for a full comprehension of the scheme.

8. *Discussion of the scheme.*—Provision to be made by rules under the Act for securing co-operation on the part of the local authority with the owners and other persons interested in the land proposed to be included in the scheme at every stage of the proceedings, by means of conferences or such other means as may be prescribed.

9. *Provision for reconstitution—*

(a) No plot to be included in the block scheme and plan on which building will not be permitted.

(b) The local authority to be empowered to propose and the controlling authority to sanction the alteration of the boundaries of the original plots so as to render them more suitable for building purposes; in order to provide plots to be held under joint ownership with the consent of the parties concerned; in order to provide plots for owners dispossessed from land required by the local authority, and generally to further the objects of the scheme.

(c) Rights in original plots to be transferred wholly or in part to reconstituted plots so far as they are capable of being transferred without prejudice to the objects of the scheme; rights which are not capable of being transferred to be extinguished; compensation to be payable by the local authority and the owners in such proportion as may be determined by the arbitrator subsequently mentioned to owners of rights injuriously affected by transfer or extinction.

Provided that agricultural leases should not be transferred to the reconstituted plots without the consent of all parties to the lease, and all rights in property acquired by the local authority should be extinguished.

10. Objections to the block scheme and plan to be made within a prescribed period by owners of the lands comprised therein and to be considered by the local authority.

11. The scheme to be submitted for approval to the controlling authority with a statement of the objections thereto, provision being made for hearing all parties interested at this stage also. After approval the scheme to be notified. The controlling authority, before granting sanction, to be empowered to make such alterations as may seem fit.

12. After declaration of intention to plan all buildings and works in contravention thereof to be prohibited. After such declaration no person to be permitted to commence or proceed with any building or carry on any work or do anything which in the opinion of the local authority is in contravention of the scheme without a certificate from the local authority.

The local authority to have power to remove, pull down, destroy, stop, or alter any building or work begun or proceeded with which in whole or part in the opinion of the local authority, to be recorded in a finding, contravenes the scheme, or for which a commencement certificate has not been obtained.

Cf. clause 56 (1) for Housing and Town Planning Bill.

No person to be entitled to compensation for such action, and expenses incurred by the local authority to be recoverable from the persons in default. But compensation to be claimable as regards work done before the date of notification of the block scheme for the purpose of finishing a building begun, or executing a contract entered into before the date of declaration of intention to prepare a town-planning scheme. Any question arising as to whether a building contravenes a scheme, or whether any provision has not been complied with, to be determined by the local authority.

13. *Finance—*

(a) The costs of the scheme to include all sums spent in the preparation and execution of the scheme, including all sums payable by the local authority not specifically excluded, and including the net difference in value between all the original and all the allotted plots as valued at the date of declaration of intention to plan without regard to prospective development.

If in any case the total value of the allotted plots exceeds the total value of the original plots estimated on the above basis, the amount of such excess to be deducted from the cost of the scheme.

(b) The costs of the scheme to be met by a contribution to be levied as follows on all allotted plots:—

(1) The original and allotted plots to be valued as at the date of declaration without considering any enhancement of value due to prospective development.

(2) When the value of the allotted plot valued on this basis is less than the value of its corresponding original plot, then the amount of contribution leviable on the allotted plot will be reduced by the amount of the difference. When it is greater, the amount of contribution will be increased by the difference.

- (3) The whole cost of the scheme will be divided amongst all the allotted plots in proportion to their increase in value when valued in accordance with (1) and when valued on the assumption that the scheme has been completed.
 - (4) When a plot is subject to a mortgage or a lease the arbitrator subsequently mentioned to determine in what proportion the mortgagee or lessee and owner shall pay the contribution.
 - (5) The contribution shall not exceed one-half the increase in value estimated to accrue to the plots under (3).
 - (6) All payments to be made so far as possible by adjustment of accounts in respect of the plot concerned, or any other plot in which the owner has an interest. In case the amount payable to an owner exceeds the amount due from him, the difference to be paid him in cash, or by any other arrangement which the local authority may make with his consent.
 - (7) The net amount due by owners may be paid in a lump sum at the option of the contributors or in such instalments as the local authority may fix with the sanction of the controlling authority.
14. After the block scheme has been approved the controlling authority to appoint an independent arbitrator whose duty it shall be to draw up the final scheme and plan in accordance with the block scheme and plan.
- (1) He will estimate the value of holdings at the date of declaration of intention to prepare a scheme, and the undeveloped and developed value of holdings allotted.
 - (2) Demarcate *in situ* the reconstituted plots, and the land required by the local authority and show boundaries.
 - (3) Determine the allotment of reconstituted plots and regulate the transfer or modified transfer of existing rights in reconstituted plots and fix compensation for rights modified or extinguished.
 - (4) Award compensation payable for rights injuriously affected by the scheme. No such compensation to be payable if provisions of such scheme are such as would have been enforced without compensation if contained in bye-laws made by the local authority under any other Act in force.
- No property deemed to be injuriously affected by reason of any provisions inserted in a scheme prescribing amount of open space to be maintained about buildings, or limiting number of buildings or prescribing their height or character.
- (5) Calculate the contribution payable on the allotted plots in proportion to their undeveloped or developed value.
15. No suit to be filed in a civil court in support of any claim which might have been made before an arbitrator.
16. The arbitrator will draw up and forward to the local authority the final scheme and plan.
17. The local authority will then notify the final scheme and plan, which will have effect as if it were enacted in the Act. After notification the local authority to have power to enforce the scheme, recovering the expenses from the persons in default.
18. All decisions of the arbitrator to be final, but the controlling authority, on receipt of an application made within 3 years by the local authority or the owners of plots comprising more than $\frac{1}{2}$ the area of the final scheme to appoint a second arbitrator to revise the valuation of holdings, made on the assumption that the improvements contemplated by the scheme have been completed.
19. A local authority as defined in the Act to be deemed to be a local authority as defined in the Local Authority's Loan Act, 1879, for the purposes of borrowing money under the Act and the execution of a town-planning scheme to be deemed to be work which such local authority is legally authorised to carry out.
20. Power to be given to the Local Government to make rules regulating procedure.

Enclosure 2 in No. 11.

From the Secretary to the Government of India, Nos. 1480-1488, dated 9th August 1912.
To the Secretary to the Government of Madras, Municipal Department; the Secretary to the Government of Bengal, Municipal Department; the Secretary to the Government of the United Provinces, Municipal Department; the Revenue Secretary to the Government of the Punjab, Municipal Department; Secretary to the Government of Burma, Municipal Department; the Secretary to the Government of Bihar and Orissa, Municipal Department; the Honourable the Chief Commissioner of the Central Provinces; the Chief Commissioner of Assam; the Honourable the Chief Commissioner and Agent to the Governor-General, North-West Frontier Province.

With reference to paragraph 6 of this Department letter Nos. 1345-54, dated 26th July 1912, in which suggestions were made for the introduction of a town-planning Act, applicable to new areas in large and growing towns, I am directed to address the Government of Madras
Bengal, &c. on the subject of the improvement of existing congested
 you
 areas in old towns.

2. The evils of overcrowding and insanitary dwellings which exist in all great cities are intimately connected with the high death rate and especially with the alarming spread of tuberculosis. No real progress in urban sanitation is possible unless these conditions

can be radically improved ; and it appears to the Government of India that while, on the one hand, local bodies fail in many instances adequately to administer the existing provisions of the Municipal Acts, in many other respects the powers they possess are insufficient for dealing satisfactorily with insanitary areas and houses.

3. It will be convenient to recapitulate briefly the chief provisions of the English Housing of the Working Classes Act, 1890 (amended by the Housing, Town-planning, etc., Act, 1909), dealing with :—

- (1) Improvement schemes for areas which have been declared insanitary, the compulsory acquisition of land in connection with such schemes, and the settlement of compensation for acquisition.
- (2) Obstructive buildings, *i.e.*, buildings which stop or impede ventilation or make other buildings unfit for human habitation or which prevent proper measures from being carried into effect for remedying any nuisance injurious to health.
- (3) Buildings unfit for human habitation.

4. I. (a) *Insanitary areas and improvement schemes.*—The provisions dealing with

* Housing of the Working Classes Act, 1890. these matters in the English Act* are intended to be set in operation by the medical officer of health to the local authority who is empowered to represent that a local area is in such an insanitary state that an improvement scheme for the reconstruction of streets or houses, or some of them, is necessary.

If twelve or more rate-payers make a representation the medical officer is bound to inspect and to make an official representation to the local authority.

The local authority must consider the report, and, if satisfied of the truth of it, they must declare the area unhealthy and prepare an improvement scheme.

If they disagree they are bound to report their reasons to the Local Government Board, which may order them to prepare and carry out the scheme. These provisions have been generally followed in Chapter III of the Calcutta Improvement Act, 1911.

(b) *Compensation for acquisition.*—Compensation for land acquired under Part I. of

Housing of the Working Classes Act, 1890. the English Act, which deals with improvement schemes, is determined by an arbitrator appointed by the confirming authority subject to an appeal to a jury in cases when the sum found due exceeds £1,000. Under section 21 of the Act compensation is payable at an estimate of fair market value, without any additional allowance in respect of the compulsory purchase of any area or any part thereof which has after enquiry been declared to be an unhealthy area, and it is further provided that in assessing compensation the arbitrator may take into consideration the fact that a house is rack rented or in an insanitary condition or unfit for human habitation and reduce the compensation accordingly. Similar provisions are contained in the Calcutta Improvement Act, 1911, the schedule of which modifies the Land Acquisition Act as applicable under the Act and in particular provides no additional compensation for compulsory acquisition.

II. *Obstructive buildings.*—Section 38 of the English Act of 1890 provides for the acquisition of obstructive buildings as defined above. The medical officer makes a representation to the local authority when he considers such a building should be demolished, and four rate-payers may also take similar action. If the local authority after hearing the owner decide to proceed, they must acquire the building and land. Compensation is determined by an arbitrator appointed by the Local Government Board, and similar provisions against excessive compensation are enacted as in section 21 of the Act. There is a further provision by which the arbitrator may apportion the compensation among the other surrounding houses to the extent to which they are increased

Vide section 38 (8) and (9) of the Act of 1890. in value by the demolition of the obstructive building, and the same may be recovered by the levy of a private improvement rate.

The owner may claim to retain the site, in which case the local authority are only bound to pay compensation for the building. In such a case no building which may be obstructive can be erected on the site. The local authority are also not bound to purchase the entire holding if, in the opinion of the arbitrator, a part can be severed without material detriment to the remainder. If the local authority fail to give effect to any order, as regards an obstructive building, the Local Government Board have power to require them to do so. The award of the arbitrator is final and binding on all parties.

III. *Unhealthy dwelling houses and power to deal with buildings unfit for human habitation.*—Under section 17 of the Housing, Town-planning, etc., Act, 1909, regular inspections have to be made and records kept of these inspections, and of action taken on them by the local authority, with a view to ascertaining whether any dwelling house is in a state so dangerous or injurious to health as to be unfit for human habitation. The

inspections are made by the medical officer of health, and he is obliged to report annually to the Local Government Board the inspection made and the action taken. Detailed regulations to this effect have been made by the Local Government Board. If the local authority have failed to take necessary action, an order may be made requiring them to do so, and this order may be enforced by *mandamus*. If a house is shown to be unfit for human habitation, a closing order is made prohibiting its use, until put into a sanitary condition. An order becomes operative at the end of 14 days if no appeal is made to the Local Government Board. When it becomes operative, notice is issued to the occupying tenants to quit within 14 days, and they can be summarily ejected at the close of that time. When an order has remained operative for three months and has not been complied with, after notice to the owner (who is given another opportunity of putting the house in order), a demolition order can be made and the expenses of demolition recovered from the owners.

5. No doubt some of these provisions are more suited to the conditions of an advanced western country than to India. But it appears to the Government of India that the provisions of the existing Acts might, in many instances, be strengthened, and extended powers conferred on selected Municipal bodies to deal with these matters on similar lines.

It is possible that a similar power of initiative to that conferred on Medical Officers of health in England might in India be entrusted to Deputy Sanitary Commissioners in provinces where such officers exist; and that failing action by the local bodies, power of effective intervention might be reserved by the local Government. The prohibitive cost of acquiring congested areas in large cities, and the necessity of contesting every disputed case in the Civil courts, prevent in practice effective action on the part of many Municipal bodies in dealing with slum areas. The provisions of the English Act, limiting excessive compensation in areas, which, after due enquiry, have been declared insanitary, appear to the Government of India to be just and reasonable, and they have already been incorporated in the Bombay and Calcutta Improvement Acts. By the appointment of an arbitrator, whose decision in the majority of cases, is final, a swift and sure procedure is provided for the settlement of disputed cases.

With regard to the acquisition and demolition of "obstructive" buildings, the Government of India desire to draw particular attention to the provision of the English Act of 1890 (section 38 (8)) by which a contribution towards the net cost of acquisition and demolition of the obstructive property can be recovered from the owners of the properties benefited by the demolition. It appears to the Government of India that by the enactment of a similar provision, the cost to the public purse could be materially reduced.

Buildings unfit for human habitation can be closed until fit for occupation, under the provisions of all Indian Municipal Acts, but there is reason to believe that these provisions are rarely enforced. A possible remedy to this neglect might be found on the lines of sections 11 and 17 of the Housing and Town Planning Act of 1909, which enforce regular inspection with report of action taken, and reserve power to the Local Government Board to intervene in case of default. But the provisions in the majority of Indian Acts are not so effective as in the English Statute, and, in particular, no power is given to demolish when a closing order remains inoperative. Further, it appears to the Government of India most desirable to give power to local bodies to declare any room, which fails to reach a prescribed standard of lighting and ventilation, unfit for human habitation, and to veto the occupation of such rooms under substantial penalties.

6. Finally, the Government of India consider it important that building bye-laws in the larger cities should be carefully examined with a view to their being made generally more efficient, and with special reference to the provision of sufficient outside air space for every room. In the view of the Government of India, the first essential for future progress, is to fix a standard of light and ventilation, and then to ensure that this standard shall be enforced and no building permitted in contravention thereof. The Government of India hope that the difficulties felt in the past, owing to the lack of trained agency, will be lessened as the scheme of reorganisation, sanctioned in their circular letter No. 2094-3001, dated the 10th November, 1911, is generally made effective in urban areas. The Government of India will be glad if they may be furnished in due

course with { the views of His Excellency the Governor in Council
His Honour the Lieutenant-Governor (in Council) } on the suggestions
your views

contained in this letter. They also think that the whole question of improvement of congested areas and other matters raised in this letter, might appropriately be discussed at the next All-India Sanitary Conference at Madras, and they will be glad if, with the

permission of { His Excellency the Governor in Council
His Honour the Lieutenant-Governor (in Council) } the delegates from
the various provinces are informed accordingly.

Enclosure 3 in No. 11.

From the Secretary to the Government of India, Nos. 1462/1472, dated 9th August, 1912, to the Chief Secretary to the Government of Madras; the Secretary to the Government of Bombay, General Department; the Secretary to the Government of Bengal Municipal (Sanitation) Department; the Secretary to the Government of the United Provinces, Municipal Department; the Revenue Secretary to the Government of the Punjab; the Secretary to the Government of Burma, General Department; the Secretary to the Government of Bihar and Orissa, Municipal Department; the Honourable the Chief Commissioner of the Central Provinces; the Honourable the Chief Commissioner of Assam, the Chief Commissioner of Coorg; the Honourable the Chief Commissioner and Agent to the Governor-General in the North-West Frontier Province.

I AM directed to address { the Government of ^{Madras} Bombay
etc. } on the subject of the
you

following matters which were discussed at the First All India Sanitary Conference which was held at Bombay in November, 1911.

2. The Government of India consider it of importance that special attention should be drawn to the note on the milk supply of large towns in India by Lieutenant-Colonel Wilkinson, I.M.S., which formed appendix 10* to the report of the Conference.

3. I am also to invite attention to Major Robertson's paper on vital statistics (appendix 13 of the report) and the suggestions made therein to the effect that medical men of the grade of Sub-Assistant surgeon should be appointed in municipalities as registering officers.

If the proposal commends itself to { His Excellency the Governor in Council
His Honour the Lieutenant-Governor in Council,
you

I am to suggest that a portion of the Sanitary grant-in-aid might suitably be devoted to this subject.

4. In view of the rapidly increasing mortality from tuberculosis—a subject which was also discussed at the Conference at Bombay [† the Government of India further desire to suggest for { the consideration of His Excellency the Governor in Council
His Honour the Lieutenant-Governor in Council } the
your consideration
formation of “anti-tuberculosis” societies,] (‡ consider it desirable that ‘anti-tuberculosis’ societies should be formed and they note that the Government of Bombay are already moving in the matter). Steps have already been taken in a few Provinces for the establishment, with the aid of private beneficence, of sanatoria for the treatment of phthisical patients. These measures are not, however, in the opinion of the Government of India, sufficient. It is necessary also to wage an active crusade against the bacillus which causes the disease in Urban areas.

The lines on which such a campaign, it is suggested, might be conducted are as follows :—

- (1) the giving of definite instruction in schools in the larger towns on the dangers of tuberculosis and the establishment of special classes for tuberculous children who should be segregated from their fellows ;
 - (2) the establishment of open air schools for children who are not tuberculous, but who are in poor condition and likely to become tuberculous ;
 - (3) the opening of tuberculosis dispensaries, and the formation of special out-patient departments for tuberculous patients in large hospitals ;
- (Here patients would be taught not only how to treat themselves but also how to minimise or prevent the risk of infection to others.)

* See p. 167.

† [] Except to Bombay.

‡ () To Bombay only.

- (4) the visitation of patients at their homes by qualified medical men and nurses with the double purpose of (a) treatment, and (b) investigation into the state of the dwelling and general conditions of life and the risk of infection to others ;
- (5) the open air treatment in special "day camps" of patients who are able to carry on their work ;
- (6) the disinfection or renovation of premises which have been vacated by death or removal of tuberculous patients ;
- (7) the formation of a league for the dissemination of a knowledge of the proper measures for prophylaxis with special reference to the dangers of promiscuous expectoration, and of overcrowding and want of fresh air and ventilation in the sleeping apartments.

5. *In the discussion on the treatment of plague and in Major Liston's paper† printed as appendix 16 to the report great stress was laid on the combination of laboratory with hospital work and on the desirability of devising practical measures for the prevention of plague. In this connection I am to forward for the information of { His Excellency the Governor in Council
His Honour the Lieutenant-Governor in Council } a copy of a memorandum containing a description of the system of travelling dispensaries which has been adopted in the United Provinces with a view to combating plague and malaria.

These dispensaries serve the double purpose of carrying surgical and medical assistance to villages in the interior as well as of overcoming prejudice against plague inoculation and of popularising that measure as well as the use of quinine and other useful medicines. Under proper supervision they have proved a great boon in bringing medical relief within reach of the rural population and have succeeded in winning the confidence of the people in the measures taken for protecting them from the ravages of plague, malaria, cholera and other diseases.

ANNEXURE TO ENCLOSURE 3 IN No. 11.

MEMORANDUM.—TRAVELLING DISPENSARIES.

The following is a general outline of the working of dispensaries in the United Provinces of which there are now 44 working. The cost of running 32 of these is met from the annual three lakh provincial plague budget, the estimated annual cost of running them being Rs. 154,668.

These 32 plague travelling dispensaries are under the direct supervision of four Indian Medical Service plague medical officers, each officer being constantly on tour supervising 8 travelling dispensaries ; these 32 plague travelling dispensaries have been allocated to the (a) Eastern, and (b) Western circles, comprising the districts usually most severely attacked by plague. A carefully selected sub-assistant surgeon has been placed in charge of each travelling dispensary.

In addition to these 32 plague travelling dispensaries there are 12 malarial travelling dispensaries, which are placed one in each of 12 districts which suffer generally most from malaria, these malaria dispensaries are under the direct supervision of civil surgeons. Owing to their great popularity 7 of the 12 district boards have offered to meet the cost of their upkeep for specific periods, while another has, in addition, offered to run two at the expense of district funds.

All travelling dispensaries—plague and malarial, and those maintained by district boards—are under the control of the Chief Plague Officer, and he is responsible for all matters dealing with the working of them, such as modifying their allocation according to the peculiarities and requirements of different districts, maintenance of all stores and equipment, etc. When cholera breaks out severely in any part of a district the travelling dispensary is at once dispatched there ; wherever malaria becomes severe these dispensaries will prove most useful agents for distributing quinine.

All the plague travelling dispensaries have been supplied with plague inoculation equipment.

The equipment supplied is as follows :—

Each Indian Medical Service officer has been given a pair of special panniers of a pattern lately brought out by Colonel O'Gorman, at Lahore.

Each sub-assistant surgeon in charge of a travelling dispensary has been supplied with an inexpensive wooden medicine box devised by the Chief Plague Officer. At the top of this box is a lift-out tray divided into 24 compartments. No wet drugs are used, the stock being comprised entirely of tablets, pills and ointments, most of which are manufactured very cheaply at the Lahore Depot.

* Not to the United Provinces and Punjab.

† See p. 175.

All pills and tablets are carried in empty air-tight Cadbury's chocolate tins fitting into the compartments in the tray purchased from various bazaars.

The space under the tray contains spare dressings and three special compartments for castor oil and rum.

In addition to this medicine box each sub-assistant surgeon is supplied with a strongly-made canvas haversack containing a central stout canvas partition running across the centre, which contains spaces for 1 oz., 2 oz., and 4 oz. bottles to fit into. Also a compartment for their instrument case (specially ordered from England); the rest of the haversack is filled with dressings, etc.

The drugs, etc., supplied are *tablets*, Quinine, Ammon-carb, Pulv Ipecac Co., Boric acid, Hydrarg perchlor, Grey powder, Aceto-salicylic acid, Salicylic acid, *pills*—Calomel Co., Calomel, Rhubarb and Colocynth, Opium, Plumbi cum Opio, Bland Co., Scillae Co. *Ointments*—Ung Hydrarg Oxidum Flavum (dil), Hydrarg nitratis, Sulphuris, Hydrarg Oxidum Rubrum, Mag: Sulp, Boro-iodoform. Vaseline, Tinct. and Lin. Iodine, absorbent wool, lint, silver nitrate sticks, German silver catheter, universal tooth forceps, and Mead's adhesive plaster.

A weekly report showing the daily number of patients treated, villages visited, and diseases for which treated, is submitted on a special form by each sub-assistant surgeon, through the supervising medical officer or civil surgeons, as the case may be, to the Chief Plague Officer.

The tour programme of each travelling dispensary is made out beforehand by the supervising medical officer or civil surgeon.

No travelling dispensary is permitted to work within a five-mile radius of any district board dispensary, and they work principally in areas badly served by the latter.

The sub-assistant surgeon halts only at the larger villages, where he is supplied with a room either in the school house or dharmshala.

Halting at these villages he works the surrounding villages within a few miles daily, his khalasi carrying his haversack.

Having halted for a period varying from one to three weeks at a large village, he moves on to another large village about 5 or 6 miles away and so on. Too frequent moves are discouraged, and sub-assistant surgeons are only allowed to draw daily allowance while in the district, no mileage being earned without the special sanction of the supervising medical officers.

The average daily number of patients treated by each dispensary is about 50; minor operations are performed, such as tapping hydroceles, trichiasis and other eye operations, dental, opening abscesses, fractures, etc.; some of the sub-assistant surgeons carry a table with them which they use as an operating table. Many urgent cases, such as controlling hæmorrhage, snake bite, etc., have been treated, and the people are in many cases forsaking their Hakims and Vaidis and coming to the travelling dispensaries.

As, in the beginning, the idea was prevalent in many places that all the white tablets were quinine, it was arranged with the Medical Storekeeper, Lahore, that he should supply the Chief Plague Officer with tablets of various colours.

In addition to the list of tablets and pills detailed above, all travelling dispensaries are supplied with bazaar drugs made up from prescriptions in use at the Agra Medical School.

One thing, however, is absolutely necessary, and that is careful and constant supervision, one fully qualified medical officer to supervise not more than 10 travelling dispensaries.

The cost of running one travelling dispensary for 12 months is Rs. 2,200.

Enclosure 4 in No. 11.

From the Secretary to the Governing Body, Indian Research Fund Association. Nos. 90/105, dated 8th July, 1912, to the Secretary to the Government of Madras, Municipal Department; the Secretary to the Government of Bombay, General Department; the Secretary to the Government of Bengal, Municipal (Sanitation) Department; the Secretary to the Government of the United Provinces, Municipal Department; the Secretary to the Government of the Punjab, Home (Medical and Sanitary) Department; the Secretary to the Government of Burma, Municipal Department; the Secretary to the Government of Bihar and Orissa, Municipal Department; the Honourable the Chief Commissioner, Central Provinces; the Chief Commissioner of Coorg; the Chief Commissioner of Assam; the Honourable the Chief Commissioner and Agent to the Governor-General, North-West Frontier Province; the Director, Central Research Institute, Kasauli; the Director, King Institute, Madras; the Director, Bacteriological Laboratory, Bombay; the Director, Pasteur Institute, Kasauli; the Director, Pasteur Institute, Coonoor.

I AM directed to forward herewith $\frac{2}{3}$ copies of the Rules and Regulations of the Indian Research Fund Association which was formed last year and has been aided by Imperial grants amounting to ten lakhs. I am to invite your attention to rules 2 and 7 and to express a hope that $\left\{ \begin{array}{c} \text{the Governor-in-Council} \\ \text{H.H. the L.-G.-in-Council, etc.,} \\ \text{you} \end{array} \right\}$ will co-operate with the Government of India in making the objects of the Association widely known.

ANNEXURE TO ENCLOSURE 4 IN No. 11,

RULES AND REGULATIONS OF THE INDIAN RESEARCH FUND ASSOCIATION.

1. The name of the Association shall be "The Indian Research Fund Association."
2. The objects for which the Association is established are the prosecution and assistance of research, the propagation of knowledge, and experimental measures generally in connexion with the causation, mode of spread and prevention of communicable diseases.
3. The president of the Association shall be the Honourable Member of the Governor General's Council in the Department of Education.
4. The entire control and management of the affairs, funds and work of the Association shall be vested in and rest with a Governing Body which shall be constituted as follows :—

President.

The Honourable Member of the Governor General's Council in the Department of Education.

Members.

The Secretary to the Government of India, Department of Education.

The Director-General, Indian Medical Service.

The Sanitary Commissioner with the Government of India.

The Director, Central Research Institute, Kasauli.

The Statistical Officer to the Government of India in the Medical and Sanitary Departments.

The Officer in charge of the Malaria Bureau.

5. The President of the Governing Body shall have the power to fill vacancies in, and make appointments to, that body.

6. The Assistant or Under Secretary to the Government of India in the Department of Education shall be, by virtue of his office, Secretary to the Governing Body.

7. The Members of the Association shall be of two classes, viz.:—(a) Permanent Members ; (b) Temporary Members.

The following shall be permanent members :—

- (1) The President and members of the Governing Body.
- (2) Every donor of Rs. 5,000 and upwards.

The following shall be temporary members :—

- (1) All members of the Working Committees hereafter mentioned, provided that they are not already permanent members of the Association.
- (2) Every subscriber of Rs. 100 and upwards annually during the currency of his subscription.

8. Every member of the Association shall be entitled to attend, and take part in the annual general meeting of the Association, and to receive copies of the reports and other publications, issued from time to time by the Association.

9. The Governing Body shall appoint a "Scientific Advisory Board," of whom not less than three shall be members of the Governing Body, who shall examine all proposals in connexion with the scientific objects of the Association, which may be submitted to the Governing Body, and report as to their feasibility. The members of such Board shall be appointed for one year but shall be eligible for re-election. They shall have power to add to their number.

10. The scientific objects of the Association shall be carried out with the aid of "Working Committees." Such committees shall be appointed by and work under the direction of the Scientific Advisory Board.

11. No scheme shall be financed by the Association, unless carried out with the sanction of the Governing Body, and approved by it, and no subscription or donation shall be made from the funds of the Association to any object which is not approved by the Governing Body.

12. Subject to the conditions laid down in rule 11, the funds of the Association (both capital and interest) shall be under the entire control of the Governing Body for the scientific objects of the Association and shall be applicable to the payment of current expenses and charges incidental to the execution of the duties of the Governing Body of the Scientific Advisory and the Working Committees under the Rules and Regulations.

13. The accounts of the Association shall be kept by the Secretary to the Governing Body in such form as the Governing Body may prescribe, and shall be audited at the end of the financial year by such officer as may be appointed for that purpose by the Government of India.

14. A statement of the accounts of the Association shall be prepared as soon as possible after the 1st of April in each year, and shall be submitted to the Governing Body, who shall prepare, for the information of the Government of India and of the members of the Association, an annual report of the proceedings and of all work undertaken during the year.

15. The Association, through its Governing Body, may accept the management of any endowment or trust fund, or subscription or donation, provided that they are unaccompanied by any condition, inconsistent or in conflict with the nature, object and provisions of the scheme. All property purchased with the funds of, or acquired by or on behalf of the Association, shall be held in the name of the President of the Governing Body.

16. A general meeting of the Association shall be held once in every year, as soon as possible after the preparation of the annual accounts and report, at such place and time as the Governing Body may appoint.

Meetings of the Governing Body, the Scientific Advisory Board, and the Working Committees shall be held as often as may be necessary.

17. The Governing Body may frame such rules as may be necessary for the discharge of business generally, including the conduct of correspondence and the holding of meetings.

Enclosure 5 in No. 11.

Resolution of the Government of India, Nos. 1524/1547, Department of Education (Sanitary), dated 19th August, 1912.

The Government of India have recently had under their consideration the position of the Sanitary Commissioner with the Government of India and the question as to what changes are necessary in the functions and duties of the appointment so as to increase its utility and efficiency.

2. In 1904 the offices of the Director General, Indian Medical Service, and Sanitary Commissioner with the Government of India, which had been amalgamated in 1880, were again separated as it was considered necessary to have a whole-time sanitary expert with the Government of India in consequence of—

- (1) the proposals for the reorganisation of the Sanitary Department throughout India made in the Report of the Plague Commission of 1901 ;
- (2) the rapid development of sanitation throughout the country, emphasising the need for specialisation in this connexion ; and
- (3) the necessity for expert advice in the organisation and direction of research following the establishment of bacteriological laboratories in India.

The Government of India had originally proposed that the Imperial Sanitary Commissioner should be subordinate to the Director General, Indian Medical Service, who, however, would not ordinarily interfere in technical sanitary questions, but abandoned the idea at the suggestion of the Secretary of State, who considered that efficiency and despatch of business would be better secured if the Sanitary Commissioner held an independent position, and that co-operation and co-ordination between the two offices could be ensured without formally subordinating the one to the other.

3. A separate appointment of Sanitary Commissioner with the Government of India was therefore created and its functions and relations to the Provincial Governments were defined in the Home Department resolution No. 1273-1290, dated the 8th September 1904. The appointment was held continuously by the Sanitary Commissioner until, in March 1911, on a vacancy occurring, the Director General, Indian Medical Service, was appointed to hold charge of the duties of the Sanitary Commissioner in addition to his own duties.

4. In the meantime the entire question was carefully reconsidered by the Government of India with special reference to certain disadvantages which had resulted from the entire separation of the appointments of Director General, Indian Medical Service, and Sanitary Commissioner. They were advised in particular that the divorce between the sanitarian and clinician which resulted from that separation had led both to loss of administrative efficiency and to the unpopularity of the specialised Bacteriological and Sanitary Departments. Increasing difficulty was experienced in recruitment, and the closer co-ordination of research and practice appeared essential if more rapid progress was to be made in the improvement of public health and the prevention of disease. Moreover the claims on the Sanitary Commissioner's time of office and bacteriological work cut short the period of touring, and rendered it difficult for him to be in such close touch with the local authorities as was desirable.

5. After correspondence with the Secretary of State and local Governments it has now been decided that a remedy for the defects of the existing system can best be provided by a systematic modification of the functions of the Sanitary Commissioner and the appointment has, therefore, been revised on the same terms as regards designation, pay and term of tenure as before.

6. With a view to secure the better co-ordination and co-operation of the Sanitary and Medical Departments, it has been decided that the Sanitary Commissioner shall in future be subordinate to the Director General, Indian Medical Service, to the extent originally recommended by the Government of India in 1904, and that the work connected with bacteriological research shall also be placed directly under the latter officer. In regard to administrative questions and matters affecting the personnel of the sanitary services, the Sanitary Commissioner will be in the position of a staff officer to the Director General, Indian Medical Service. He will be given independent authority in technical sanitary matters, with power as at present to correspond direct with the Government of India. He will occupy the position in regard to local Governments and the officers under them laid down in paragraph 12 of the resolution No. 1273-1290, dated 8th September, 1904. In order to relieve him of as much routine work as possible the office establishments of the Sanitary Commissioner and the Director General, Indian Medical Service, will be amalgamated. The Statistical Officer will, in future, assist the Director General, Indian Medical Service, in the control of the sanitary section of the office as well as in

the guidance of research work and the Bacteriological Department. He will also edit "Paludism" and the "Scientific Memoirs" under the direction of the Director General, and his designation will be altered to that of the Secretary to the Director General, Indian Medical Service (Sanitary). The Sanitary Commissioner will, under these arrangements, be able to tour freely and regularly throughout India with a view to co-ordinate the lines of development, to inspect works of sanitation actually in progress, to advise on projected schemes and generally to disseminate the knowledge acquired in the different provinces.

7. The statement attached to this Resolution contains details of grants which have been made in recent years from Imperial Revenues towards sanitation and research. In every province important schemes for the improvement of urban sanitation are now in course of execution. A preliminary survey has been in progress in several provinces with a view to the preparation of schemes designed to effect the improvement of malarial conditions and in particular to extirpate if possible the anopheles mosquito in selected areas. Projects are now ready in more than one province, and grants are being made for their execution from Imperial Revenues. The data thus obtained will, it is hoped, be of very great value in planning future preventive measures. The important questions of controlling and regulating the expansion of growing towns, and of strengthening the existing powers of local authorities in dealing with congested urban areas are ripe for consideration and discussion and the Government of India have recently addressed local Governments on these subjects. A scheme for the general reorganisation of the sanitary services throughout India has received the sanction of the Secretary of State, and with the introduction of a trained staff a general improvement in the condition of urban sanitation may reasonably be expected. A wide sphere of useful work, therefore, lies before the Sanitary Commissioner as an advisory authority, and the Government of India believe that the appointment under its new conditions will be of increased benefit to themselves and to local Administrations.

ORDER.—Ordered that a copy of this resolution be communicated to all local Governments* and Administrations,† to all Departments‡ of the Government of India, to the Director General, Indian Medical Service, and to the Sanitary Commissioner with the Government of India for information.

Ordered also that a copy be published in the *Gazette of India* for general information.

(Signed) L. C. PORTER,
Secretary to the Government of India.

ANNEXURE TO ENCLOSURE 5 IN No. 11.

STATEMENT SHOWING THE GRANTS MADE IN RECENT YEARS TO PROVINCIAL GOVERNMENTS FROM IMPERIAL REVENUES FOR SANITATION.

1. In addition to the annual recurring Imperial grant of 30 lakhs which was made in 1908 for expenditure on sanitary improvements with special reference to the prevention of plague, a special non-recurring grant of 57 lakhs was made in 1910-11, of which 5 lakhs were intended for the promotion of research and the balance was allotted for expenditure on urban sanitary works in the various provinces. The grants for urban sanitation were distributed as follows :—

	Rs.
Madras	4,25,000
Bombay	4,25,000
Bengal	10,00,000
United Provinces... ..	10,50,000
Punjab	5,00,000
Burma	4,00,000
Eastern Bengal and Assam	4,00,000
Central Provinces	2,00,000

A sum of 50 lakhs was given in addition as a grant towards the works being carried out by the Bombay Improvement Trust.

With the nucleus of 5 lakhs for the promotion of research, the following steps have been taken. Major James has been deputed to the Panama Canal to investigate yellow fever in its endemic area. An enquiry in connexion with a disease known as Kala Azar is being conducted by Captain Mackie and Dr. Korke and another enquiry regarding cholera by Major Greig and Captain Gloster. Mr. Howlett, the Imperial entomologist, has been provided with assistants for conducting research on disease-carrying insects.

2. In 1911-12 further special grants of 50 lakhs towards approved sanitary schemes in urban areas, and of 10 lakhs for research and prevention work were made.

* Madras, Bombay, Bengal, United Provinces, Punjab, Burma, Bihar and Orissa.

† Central Provinces, Assam, Coorg, North-West Frontier Province.

‡ Home, Foreign, Finance, Revenue and Agriculture, Commerce and Industry, Public Works Department, Railway, Legislative, Army, Finance (Military Finance).

The grant of 50 lakhs were distributed as follows :—

	Rs.
Madras	8,00,000
Bombay	6,50,000
Bengal	7,25,000
United Provinces...	8,00,000
Punjab	6,17,000
Burma	4,00,000
Bihar and Orissa ...	4,62,000
Central Provinces ...	4,00,000
Assam	1,46,000

Of the 10 lakhs for research, 4 lakhs have been expended on refitting and extending laboratories as follows :—

	Rs.
(a) Improving and refitting the laboratories at Parel	2,00,000
(b) Construction and equipment of laboratory at Rangoon ...	1,15,000
(c) Establishment of a bacteriological laboratory in connection with the Pasteur Institute at Maymyo	85,000

Rs. 50,000 has been given for the extension of the Central Research Institute, Kasauli, and Rs 50,000 as a grant for extension of rat-proof buildings in Fraser Town, Bangalore, as an experimental measure against plague.

Five lakhs will be distributed among various provincial Governments as a grant towards matured anti-malarial schemes, and also for an anti-stegomyia survey in the chief ports of India as a preliminary to measures against the importation of yellow fever.

3. In addition, the sum of about $4\frac{1}{2}$ lakhs has been distributed among minor administrations during the last two years, and a subvention of 25 lakhs has been made towards the waterworks and drainage scheme of the city of Madras.

4. A recurring grant of $2\frac{1}{2}$ lakhs per annum has been made to assist local Governments in introducing the scheme for reorganisation of the Sanitary services sanctioned by the Secretary of State.

5. During the last two years the Imperial grants for sanitation have aggregated $181\frac{1}{2}$ lakhs, and for research work 15 lakhs.

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